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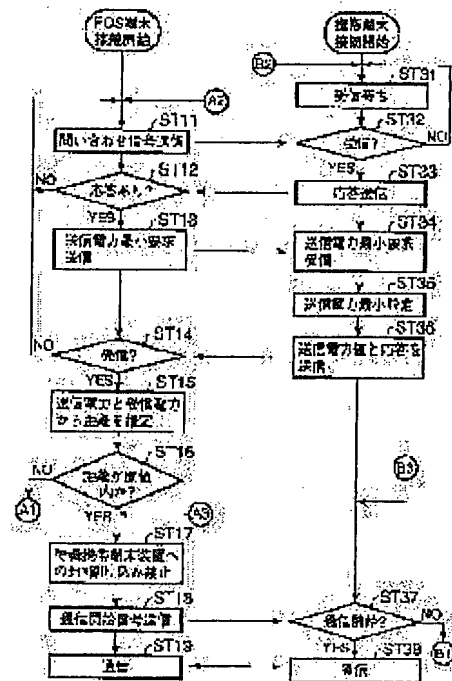
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## (54) METHOD AND SYSTEM FOR RADIO COMMUNICATION

(57)Abstract:

**PROBLEM TO BE SOLVED:** To perform radio communication without complicated operation when performing the radio communication while specifying radio communication equipment to be communicated.

**SOLUTION:** Radio POS terminal equipment transmits an inquiry signal to portable terminal equipment and when this signal is received, the portable terminal equipment returns a response. Then, the radio POS terminal equipment transmits a transmitting power minimizing request to the portable terminal equipment. When this request is received, the portable terminal equipment sets a transmitting power to a minimum and transmits a transmitting power value and a response to the POS terminal equipment. The POS terminal equipment, which receives these value and response, estimates a distance to the portable terminal equipment from the transmitting power value contained in the received signal and actually received power and when that distance is within a threshold, communication with the portable terminal equipment is started.



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## CLAIMS

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[Claim(s)]

[Claim 1] It is the radio approach which transmits the radio signal which equipped the 2nd radio communication equipment with transmitted power information from the 1st radio communication equipment, and is characterized by for said 2nd radio communication equipment to receive said radio signal, to acquire received-power information, and to compute distance with said 1st radio communication equipment from this acquired received-power information and the transmitted power information on said radio signal, and to perform said the 1st radio communication equipment and radio if this computed distance is in a predetermined value.

[Claim 2] It is the radio approach according to claim 1 which the 1st radio communication equipment makes include the transmitted power information set up when transmitting a radio signal in the radio signal, transmits it, and is characterized by said 2nd radio communication equipment computing distance with said 1st radio communication equipment from the acquired received-power information and the transmitted power information included in said radio signal.

[Claim 3] It is the radio approach according to claim 2 characterized by for the 2nd radio communication equipment transmitting a radio signal including the assignment information on transmitted power to the 1st radio communication equipment, and for said 1st radio communication equipment setting up transmitted power based on the assignment information on the transmitted power contained in said radio signal, including it in a radio signal by making this transmitted power into transmitted power information, and transmitting to said 2nd radio communication equipment.

[Claim 4] The assignment information on the transmitted power transmitted to the 1st radio communication equipment from the 2nd radio communication equipment is the radio approach according to claim 3 characterized by being the assignment information which makes transmitted power min.

[Claim 5] Said 2nd radio communication equipment while asking the 2nd or 1st radio communication equipment from the 1st or 2nd radio communication equipment and transmitting a signal, after asking said 1st or 2nd radio communication equipment from said 2nd or 1st radio communication equipment, transmitting the reply signal over a signal and checking a partner is the radio approach according to claim 3 characterized by transmitting a radio signal including the assignment information on transmitted power to said 1st radio communication equipment.

[Claim 6] It is the radio approach according to claim 1 characterized by computing distance with said 1st radio communication equipment from the received-power information from which the 1st radio communication equipment was transmitted as a radio signal, and said 2nd radio communication equipment acquired the reference signal with which transmitted power was fixed beforehand, and the transmitted power of said reference signal.

[Claim 7] While asking the 2nd or 1st radio communication equipment from the 1st or 2nd radio communication equipment and transmitting a signal After asking said 1st or 2nd radio communication equipment from said 2nd or 1st radio communication equipment, transmitting the reply signal over a signal and checking a partner, It is the radio approach according to claim 6

characterized by for said 2nd radio communication equipment transmitting the demand signal of a reference signal to said 1st radio communication equipment, and said 1st radio communication equipment transmitting a reference signal based on a demand signal.

[Claim 8] It is the radio approach according to claim 5 or 7 which makes the 1st radio communication equipment as personal digital assistant equipment, makes the 2nd radio communication equipment a key station, and is characterized by to be in a receiving-waiting machine condition, holding the synchronization of transceiver timing with said key station if said key station transmits a standby signal to the personal digital assistant equipment when distance with the computed personal digital assistant equipment is over the predetermined value, and said personal digital assistant equipment receives a standby signal.

[Claim 9] In the radio communications system which performs radio between the 1st radio communication equipment and the 2nd radio communication equipment said 2nd radio communication equipment An acquisition means to receive a radio signal including the transmitted power information transmitted from said 1st radio communication equipment, and to acquire the received power of this radio signal, A calculation means to compute distance with said 1st radio communication equipment from the received power which this acquisition means acquired, and the transmitted power information included in said radio signal, The radio communications system characterized by having a radio means to perform said 1st radio communication equipment and radio when the distance which this calculation means computed is in a predetermined value.

[Claim 10] It is the radio communications system according to claim 9 characterized by having a setting means by which said 1st radio communication equipment sets up the transmitted power of self in the radio communications system which performs radio between the 1st radio communication equipment and the 2nd radio communication equipment, and a transmitting means to transmit a radio signal including the transmitted power information which this setting means set up.

[Claim 11] In the radio communications system which performs radio between the 1st radio communication equipment and the 2nd radio communication equipment said 2nd radio communication equipment An acquisition means to receive the reference signal transmitted from said 1st radio communication equipment, and to acquire the received power of this reference signal, A calculation means to compute distance with said 1st radio communication equipment from the received power which this acquisition means acquired, and the transmitted power information beforehand set up to said reference signal, The radio communications system characterized by having a radio means to perform said 1st radio communication equipment and radio when the distance which this calculation means computed is in a predetermined value.

[Claim 12] It is the radio communications system according to claim 11 characterized by having a setting means to set the transmitted power of the reference signal which transmits said 1st radio communication equipment to said 2nd radio communication equipment in the radio communications system which performs radio between the 1st radio communication equipment and the 2nd radio communication equipment as the transmitted power set up beforehand, and a transmitting means to transmit a reference signal with the transmitted power which this setting means set up.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] This invention relates to the radio approach and radio communications system with which a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments, and performs radio.

#### [0002]

[Description of the Prior Art] As a system by which a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments, and performs radio, what was indicated by JP,11-184947,A is known, for example. This performs electronic banking, when the electronic value reception equipment which gave the function of the base station of a PHS terminal to the function of the PHS terminal which holds cybermoney, and the POS terminal arranged in the cash payment location of a store performs radio. As a procedure of establishing the communication link of a PHS terminal and electronic value reception equipment, the PHS terminal which inputs the number for specifying the PHS terminal which a user uses from the number input keyboard connected to electronic value reception equipment, performs call origination to the PHS terminal with which electronic value reception equipment is specified by the number, and performs electronic banking is specified.

#### [0003]

[Problem(s) to be Solved by the Invention] In this system, when electronic banking was performed, since the PHS terminal which he has was specified before performing electronic banking, the visitor had to input the number from the number input keyboard, and had the problem that time and effort was taken for this reason, and settlement of accounts with electronic value reception equipment took time amount. Moreover, when the visitor had the trouble which must memorize the number for specifying PHS and he sometimes forgot the number, there was a problem of electronic banking becoming impossible.

[0004] Then, invention according to claim 1 to 8 offers the radio approach that radio can be performed, without applying troublesome time and effort, when a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments and performs radio. Moreover, invention according to claim 9 to 12 offers the radio communications system which can perform radio, without applying troublesome time and effort, when a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments and performs radio.

#### [0005]

[Means for Solving the Problem] Invention according to claim 1 transmits the radio signal which equipped the 2nd radio communication equipment with transmitted power information from the 1st radio communication equipment, and the 2nd radio communication equipment receives a radio signal, acquires received-power information, computes distance with the 1st radio communication equipment from this received-power information and transmitted power information on a radio signal that were acquired, and if this computed distance is in a predetermined value, it is in the radio approach of performing the 1st radio communication equipment and radio.

[0006] In the radio approach according to claim 1, the 1st radio communication equipment includes the transmitted power information set up when transmitting a radio signal in the radio signal, invention according to claim 2 transmits it, and the 2nd radio communication equipment is to compute distance with the 1st radio communication equipment from the acquired received-power information and the transmitted power information included in the radio signal.

[0007] Invention according to claim 3 transmits the radio signal in which the 2nd radio communication equipment includes the assignment information on transmitted power to the 1st radio communication equipment in the radio approach according to claim 2, and the 1st radio communication equipment is to set up transmitted power based on the assignment information on the transmitted power contained in a radio signal, make it contain in a radio signal by making this transmitted power into transmitted power information, and transmit to the 2nd radio communication equipment.

[0008] The assignment information on the transmitted power which invention according to claim 4 transmits to the 1st radio communication equipment from the 2nd radio communication equipment in the radio approach according to claim 3 is to have considered as the assignment information which makes transmitted power min.

[0009] In the radio approach according to claim 3, while invention according to claim 5 asks the 2nd or 1st radio communication equipment from the 1st or 2nd radio communication equipment and transmits a signal After asking the 1st or 2nd radio communication equipment from the 2nd or 1st radio communication equipment, transmitting the reply signal over a signal and checking a partner, the 2nd radio communication equipment is to transmit a radio signal including the assignment information on transmitted power to the 1st radio communication equipment.

[0010] It is in computing distance with the 1st radio communication equipment from the received-power information and the transmitted power of a reference signal with which it transmitted as a radio signal and the 2nd radio communication equipment acquired the reference signal with which, as for invention according to claim 6, transmitted power was beforehand fixed in the radio approach according to claim 1, as for the 1st radio communication equipment.

[0011] In the radio approach according to claim 6, while invention according to claim 7 asks the 2nd or 1st radio communication equipment from the 1st or 2nd radio communication equipment and transmits a signal After asking the 1st or 2nd radio communication equipment from the 2nd or 1st radio communication equipment, transmitting the reply signal over a signal and checking a partner, It is in the 2nd radio communication equipment transmitting the demand signal of a reference signal to the 1st radio communication equipment, and the 1st radio communication equipment transmitting a reference signal based on a demand signal.

[0012] Invention according to claim 8 is set to the radio approach according to claim 5 or 7. Make the 1st radio communication equipment as personal digital assistant equipment, make the 2nd radio communication equipment into a key station, and when distance with the computed personal digital assistant equipment is over the predetermined value, a key station Transmitting a standby signal to the personal digital assistant equipment, personal digital assistant equipment is to be in a receiving waiting machine condition, holding the synchronization of transceiver timing with a key station, if a standby signal is received.

[0013] In the radio communications system with which invention according to claim 9 performs radio between the 1st radio communication equipment and the 2nd radio communication equipment the 2nd radio communication equipment An acquisition means to receive a radio signal including the transmitted power information transmitted from the 1st radio communication equipment, and to acquire the received power of this radio signal, It is in having had the 1st radio communication equipment and a radio means to perform radio, when the distance which a calculation means to compute distance with the 1st radio communication equipment from the received power which this acquisition means acquired, and the transmitted power information included in a radio signal, and this calculation means computed was in a predetermined value.

[0014] Invention according to claim 10 has the 1st radio communication equipment in having had a setting means to set up the transmitted power of self, and a transmitting means to transmit a radio signal including the transmitted power information which this setting means set up in a radio communications system according to claim 9.

[0015] In the radio communications system with which invention according to claim 11 performs radio between the 1st radio communication equipment and the 2nd radio communication equipment the 2nd radio communication equipment An acquisition means to receive the reference signal transmitted from the 1st radio communication equipment, and to acquire the received power of this reference signal, It is in having had the 1st radio communication

equipment and a radio means to perform radio, when the distance which a calculation means to compute distance with the 1st radio communication equipment from the transmitted power information beforehand set up to the received power and the reference signal which this acquisition means acquired, and this calculation means computed was in a predetermined value. [0016] Invention according to claim 12 has the 1st radio communication equipment in having had a setting means to set the transmitted power of the reference signal transmitted to the 2nd radio communication equipment as the transmitted power set up beforehand, and a transmitting means to transmit a reference signal with the transmitted power which this setting means set up in a radio communications system according to claim 11.

[0017]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

(Gestalt of the 1st operation) Drawing 1 is drawing showing the configuration of the wireless POS system which is a radio communications system, and it is the wireless POS (point of sale) terminal unit with which 1 and 2 were equipped with the personal digital assistant equipment as the 1st radio communication equipment, and 3 was equipped with the 2nd radio communication equipment.

[0018] Said wireless POS terminal 3 is paid in a store, is installed in the settlement-of-accounts section which is a location, registers the goods which the customer purchased, performs settlement-of-accounts processing in response to the payment from a customer, and publishes a receipt. Payment has come to be able to do said personal digital assistant equipments 1 and 2 using the money electronized because cash like a mobile cache and the electronized money which can be used similarly are memorized as data and communicates with said wireless POS terminal 3 at the time of registration of goods.

[0019] The wireless section 100 from which said wireless POS terminal 3 constitutes said personal digital assistant equipments 1 and 2 and the 2nd radio communication equipment which performs radio as shown in drawing 2, the cash register Management Department 111 which performs the whole management of operation, self identification information, Some POS data The enclosure LAN 114 of input devices, such as the store 112 and keyboard which memorize the data for employing equipment etc., and a scanner, and I/O device 113 containing output units, such as a receipt issue machine which has a display and a printer, is minded. It has the communication link unit 115 for yard LAN which communicates with a store server.

[0020] Said wireless section 100 The receiving signal strength display which outputs the RSSI value of the radio signal which an antenna 101, the antenna change section 102, the receive section 103, the received-data transducer 104 that restores to the radio signal which this receive section 103 received, and is changed into digital data, and said receive section 103 received (RSSI) It is constituted by the transmitted power control section 109 which controls the transmitted power of the section 105, the radio control section 106, the transmitting section 107, the transmit data transducer 108 that modulates digital data, changes into a sending signal, and is outputted to said transmitting section 107, and said transmitting section 107.

[0021] As shown in drawing 3, said radio control section 106 The sign for a preamble or transmission error control in judging the existence of a transmission error from the digital data from a received-power acquisition means 121 to acquire a received-power value from the RSSI value from said receiving signal strength display 105, and said received-data transducer 104 \*\*\*\* It can remove and received data can be acquired. Again From the received-power value which a received-data acquisition means 122 to acquire the transmitted power value when the transmitted power value is included in the digital data, and said received-power acquisition means 121 acquired, and the transmitted power value which said received-data acquisition means 122 acquired A distance presumption means 123 to presume the distance of said personal digital assistant equipment 1 or 2 is established.

[0022] Said radio control section 106 again When transmitting the transmit data creation means 124 and transmit data which perform coding for header information or transmission error control, and are outputted to said transmit data transducer 108 so that it may be suitable for a transmission format of the wireless section in transmit data A transmitted power acquisition

means 126 to acquire the transmitted power value set up with a transmitted power setting means 125 to set up a \*\*\*\*\* power value and to output to said transmitted power control section 109, and this transmitted power setting means 125 is established. In addition, said transmit data creation means 124 can also include the transmitted power value which said transmitted power acquisition means 126 acquired in transmit data.

[0023] Said radio control section 106 has established further an antenna change setting means 127 to set up the antenna change of said antenna change section 102, and a transmission means 128 to perform data transmission with said cash register Management Department 111.

Furthermore, the timer means 129 is included in said radio control section 106, and after the set-up time amount passes, an interrupt occurs and it is used for processing of the transmission after setup-time progress, the time-out of the receiving latency time, etc.

[0024] If the wireless section 100 starts in said wireless POS terminal 3, the antenna change setting means 127 in the radio control section 106 will set up so that a receive section 103 may connect the antenna change section 102 with an antenna 101, and will change the wireless section 100 into the waiting state waiting for receiving.

[0025] If a radio signal is received by said antenna 101, this input signal will be inputted into a receive section 103 via the antenna change section 102. A receive section 103 changes a frequency low while amplifying the received signal. The received-data transducer 104 restores to the signal from a receive section 103, changes it into digital data, and is outputted to the received-data acquisition means 122 of the radio control section 106. The receiving signal strength display 105 outputs the RSSI value of the reception output of a receive section 103 to the received-power acquisition means 121 of the radio control section 106.

[0026] And in the radio control section 106, the received-power acquisition means 121 acquires a received-power value from a RSSI value, the received-data acquisition means 122 acquires a transmitted power value from digital data, and the distance presumption means 123 presumes distance with personal digital assistant equipment from a received-power value and a transmitted power value. For example, it gets down to the location where those who own personal digital assistant equipment 1 pay, and supposing those who own personal digital assistant equipment 2 have stood in a line after that, first, the radio signal from personal digital assistant equipment 1 will be received, and distance with the personal digital assistant equipment 1 will be presumed. The radio control section 106 operates transmitting received data to the cash register Management Department 111 from a send action or the transmission means 128 etc. according to the contents of the received data.

[0027] Moreover, if transmit data is generated in the radio control section 106, a transmitted power value in case the transmitted power setting means 125 transmits transmit data is set up, thereby, the transmitted power of the transmitting section 107 will be controlled according to the transmitted power value to which the transmitted power control section 109 was set, and the transmitting output of the transmitting section 107 will be made into the set point. The transmitted power acquisition means 126 acquires the transmitted power value which the transmitted power setting means 125 set up, and the transmit data creation means 124 includes a transmitted power value, and creates digital transmit data, and it outputs it to the transmit data transducer 108.

[0028] The antenna change setting means 127 controls the antenna change section 102, connects the transmitting section 107 with an antenna 101, and the transmit data transducer 108 modulates the created digital transmit data, and it outputs it to the transmitting section 107, and the transmitting section 107 changes the modulated signal into a radio frequency, and it outputs a sending signal with the set-up transmitted power value. A sending signal is transmitted as a radio signal from an antenna 101 via the antenna change section 102. Moreover, although not illustrated, it is also possible to transmit the data acquired with the received-data acquisition means 122 to the transmission means 128, and it is also possible to transmit data to the transmit data creation means 124 from the transmission means 128.

[0029] As said personal digital assistant equipments 1 and 2 are shown in drawing 4 Said wireless POS terminal 3 and radio The management of the wireless section 200 and the whole of operation to perform When you telephone a partner using the input key 214 which prepared the

storage 213 which memorizes information, such as the terminal management section 211 to perform, the indicator 212 which displays information, the identification information and the telephone directory of a terminal, and a mobile cache, the key which a user uses for a figure input or submission operation, and a public line. It has the radio unit 216 for public lines which performs the base station and radio of the voice-input/output equipment 215 to be used and a public line.

[0030] Said wireless section 200 The receiving signal strength display which outputs the RSSI value of the radio signal which an antenna 201, the antenna change section 202, the receive section 203, the received-data transducer 204 that restores to the signal which this receive section 203 outputted, and is changed into digital data, and said receive section 203 received (RSSI) It is constituted by the transmitted power control section 209 which controls the transmitted power of the section 205, the radio control section 206, the transmitting section 207, the transmit data transducer 208 that modulates digital data, changes into a sending signal, and is outputted to said transmitting section 207, and said transmitting section 207.

[0031] As shown in drawing 5, said radio control section 206 The sign for a preamble or transmission error control in judging the existence of a transmission error from the digital data from a received-power acquisition means 221 to acquire a received-power value from the RSSI value from said receiving signal strength display 205, and said received-data transducer 204 \*\*\*\* It can remove and received data can be acquired. Again From the received-power value which a received-data acquisition means 222 to acquire the transmitted power value when the transmitted power value is included in the digital data, and said received-power acquisition means 221 acquired, and the transmitted power value which said received-data acquisition means 222 acquired A distance presumption means 223 to presume distance with said wireless POS terminal 3 is established.

[0032] Said radio control section 206 again When transmitting the transmit data creation means 224 and transmit data which perform coding for header information or transmission error control, and are outputted to said transmit data transducer 208 so that it may be suitable for a transmission format of the wireless section in transmit data A transmitted power acquisition means 226 to acquire the transmitted power value set up with a transmitted power setting means 225 to set up a \*\*\*\*\* power value and to output to said transmitted power control section 209, and this transmitted power setting means 225 is established. In addition, said transmit data creation means 224 can also include the transmitted power value which said transmitted power acquisition means 226 acquired in transmit data.

[0033] Said radio control section 206 has established further an antenna change setting means 227 to set up the antenna change of said antenna change section 202, and a transmission means 228 to perform data transmission with said terminal management section 211. Furthermore, the timer means 229 is included in said radio control section 206, and after the set-up time amount passes, an interrupt occurs and it is used for processing of the transmission after setup-time progress, the time-out of the receiving latency time, etc.

[0034] If the wireless section 200 starts in said personal digital assistant equipment 1 or 2, the antenna change setting means 227 in the radio control section 206 will set up so that a receive section 203 may connect the antenna change section 202 with an antenna 201, and will change the wireless section 200 into the waiting state waiting for receiving.

[0035] If a radio signal is received by said antenna 201, this input signal will be inputted into a receive section 203 via the antenna change section 202. A receive section 203 changes a frequency low while amplifying the received signal. The received-data transducer 204 restores to the signal from a receive section 203, changes it into digital data, and is outputted to the received-data acquisition means 222 of the radio control section 206. The receiving signal strength display 205 outputs the RSSI value of the reception output of a receive section 203 to the received-power acquisition means 221 of the radio control section 206.

[0036] And in the radio control section 206, the received-power acquisition means 221 acquires a received-power value from a RSSI value, the received-data acquisition means 222 acquires a transmitted power value from digital data, and the distance presumption means 223 presumes distance with wireless POS terminal 3 from a received-power value and a transmitted power



value. The radio control section 206 operates transmitting received data to the terminal management section 211 from a send action or the transmission means 228 etc. according to the contents of the received data.

[0037] Moreover, if transmit data is generated in the radio control section 206, a transmitted power value in case the transmitted power setting means 225 transmits transmit data is set up, thereby, the transmitted power of the transmitting section 207 will be controlled according to the transmitted power value to which the transmitted power control section 209 was set, and the transmitting output of the transmitting section 207 will be made into the set point. The transmitted power acquisition means 226 acquires the transmitted power value which the transmitted power setting means 225 set up, and the transmit data creation means 224 includes a transmitted power value, and creates digital transmit data, and it outputs it to the transmit data transducer 208.

[0038] The antenna change setting means 227 controls the antenna change section 202, connects the transmitting section 207 with an antenna 201, and the transmit data transducer 208 modulates the created digital transmit data, and it outputs it to the transmitting section 207, and the transmitting section 207 changes the modulated signal into a radio frequency, and it outputs a sending signal with the set-up transmitted power value. A sending signal is transmitted as a radio signal from an antenna 201 via the antenna change section 202. Moreover, although not illustrated, it is also possible to transmit the data acquired with the received-data acquisition means 222 to the transmission means 228, and it is also possible to transmit data to the transmit data creation means 224 from the transmission means 228.

[0039] Drawing 6 is the flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom wireless POS terminal 3 communicates, and personal digital assistant equipment, and first, wireless POS terminal 3 asks it by ST11, and it transmits a signal to personal digital assistant equipment. An inquiry signal is the inquiry which was made to contain the identification information of a local station and was addressed to many and unspecified personal digital assistant equipments. When personal digital assistant equipment does not exist in a perimeter, those without a response are judged in the judgment of the response existence in ST12, and it returns to transmission of the inquiry signal of ST11.

[0040] On the other hand, personal digital assistant equipment is in a receiving waiting state by ST31, and if it asks by ST32 and reception of a signal is judged, the response in which the identification information of wireless POS terminal 3 and the identification information of a local station which have asked by ST33 were included will be transmitted. Personal digital assistant equipment takes the synchronization of transceiver timing with a wireless POS terminal, when an inquiry signal is received, and it establishes a communication link. In order to take the synchronization of transceiver timing depending on the correspondence procedure used at this time, the exchange of a radio signal may occur further.

[0041] Wireless POS terminal 3 will transmit the demand which makes transmitted power min to addressing to personal digital assistant equipment which had the response by ST13, if those with a response are judged by ST12. Personal digital assistant equipment will transmit the instruction with which the transmitted power setting means 225 makes transmitted power min at the transmitted power control section 209 by ST35, if the demand which makes transmitted power min by ST34 is received, and the transmitted power control section 209 is set up so that the transmitting output of the transmitting section 207 may become min. Moreover, the transmitted power setting section 225 tells the set point to the transmitted power acquisition means 226, and the transmitted power acquisition means 226 acquires transmitted power from the set point, and it tells this acquired transmitted power value to the transmit data creation means 224.

[0042] Thus, making transmitted power into min can reduce wire tapping which narrows the range which can receive the information which personal digital assistant equipment transmits, and is malicious while it is effective in avoiding the communication link with the personal digital assistant equipment which is separated from the wireless POS terminal. Furthermore, it is effective in stopping the power consumption of personal digital assistant equipment.

[0043] Then, by ST36, personal digital assistant equipment creates the response whose transmit

data creation means 224 includes the transmitted power value received from the transmitted power acquisition means 226, and is transmitted. Wireless POS terminal 3 is waiting for the response after transmitting the demand which makes transmitted power min, and judges whether the response was received by ST14. Even if it passes beyond fixed time amount, when a response is unreceivable, it judges that it is not approaching within limits with which the personal digital assistant equipment which transmitted the demand which makes transmitted power min communicates, and returns to ST11.

[0044] If the response from the personal digital assistant equipment which made transmitted power min is received, a RSSI value will be inputted into the received-power acquisition means 121 from the receiving signal strength display 105, received power will be acquired, and it will be told to the distance presumption means 123. Moreover, the radio signal which received is inputted into the received-data acquisition means 122 as digital data, and the received-data acquisition means 122 acquires the transmitted power of the personal digital assistant equipment contained in the received data, and tells the distance presumption means 123. And distance is presumed from the transmitted power of personal digital assistant equipment and received power which were received by ST15.

[0045] When power transmitted from personal digital assistant equipment is set to  $P_t$  (dBm), power which wireless POS terminal 3 receives is set to  $P_i$  (dBm) and wavelength of a wireless electric wave is set to  $\lambda$  (m), the distance  $D$  of personal digital assistant equipment and wireless POS terminal 3 (m) is [Equation 1].

$$D = \frac{\lambda}{4\pi \times 10^{(P_i - P_t)/20}} \quad \dots (1)$$

It becomes. If power with which 0dBm and a wireless POS terminal receive as an example the power transmitted from personal digital assistant equipment is set to -30dBm and a radio frequency is set to 2.45GHz, the distance of personal digital assistant equipment and wireless POS terminal 3 can be presumed to be 0.308m. Moreover, by using the above-mentioned (1) formula, even when the personal digital assistant equipment with which transmitted power differs exists, distance can be presumed.

[0046] In this way, presumption of distance judges whether the distance presumed by ST16 is in a threshold. At a supermarket and a convenience store, since arrangement of a wireless POS terminal differs from the train of turn waiting, the threshold of distance changes with use gestalten of a wireless POS terminal. For example, in a supermarket, the threshold of distance is set to 0.5m, and if the distance of wireless POS terminal 3 and personal digital assistant equipment is in a threshold, the timer interruption for transmitting to the personal digital assistant equipment which is standing by by ST17 will be forbidden. Moreover, if the distance of wireless POS terminal 3 and personal digital assistant equipment is over the threshold, processing will shift to A1 of drawing 7.

[0047] Then, wireless POS terminal 3 transmits the communication link start signal which tells communication link initiation by ST18 to personal digital assistant equipment, and communicates by ST19. On the other hand, personal digital assistant equipment starts a communication link by ST38, when it judges whether it is communication link initiation by ST37 and a communication link start signal is received. Moreover, when not receiving a communication link start signal, processing shifts to B1 of drawing 7.

[0048] Thus, wireless POS terminal 3 communicates by ST19, and personal digital assistant equipment communicates by ST38, and it processes informational exchange etc. Thereby, a wireless POS terminal can limit one personal digital assistant equipment which is in the communication link range out of two or more personal digital assistant equipments.

[0049] It is more efficient to establish the communication link with personal digital assistant equipment freely, even if it does not communicate by judging that distance is separated about the personal digital assistant equipment which will approach wireless POS terminal 3 immediately like the personal digital assistant equipment 2 which those who have stood in a line by turn waiting in drawing 1 own.

[0050] Although personal digital assistant equipment took the synchronization of wireless POS

terminal 3 and transceiver timing and has established the communication link when an inquiry signal is received, it is made to stand by about the personal digital assistant equipment which will approach wireless POS terminal 3 immediately like personal digital assistant equipment 2, where a communication link is established.

[0051] If it is received by POS terminal 3 and the transmitted power value and response which were transmitted by ST36 from personal digital assistant equipment are judged that distance is further than a threshold by ST16, it will shift to A1 of drawing 7, and will judge whether it goes into standby within the limits whose distance is the 2nd threshold by ST20. What is necessary is just to set the standby range in this case to less than 1.5m from POS terminal 3 that what is necessary is just to consider the distance located in a line by the waiting for settlement of accounts. Presumption of distance should just use the result of ST15.

[0052] personal digital assistant equipment -- standby -- when it is judged that it is out of range, POS terminal 3 judges that the personal digital assistant equipment and communication link are not performed, and returns to ST11. In order for personal digital assistant equipment not to have reception of a communication link start signal at ST37 even if fixed time amount passes, and not to receive a standby signal by ST39 at this time, either, it returns to ST31.

[0053] When it is judged that wireless POS terminal 3 exists in personal digital assistant equipment's standby within the limits, a standby signal is transmitted to personal digital assistant equipment by ST21. Personal digital assistant equipment will serve as waiting for reception, holding the synchronization of transceiver timing by ST40, if a standby signal is received by ST39.

[0054] After transmitting a standby signal, wireless POS terminal 3 communicates periodically, in order to consider the check of distance as synchronous maintenance of transceiver timing with personal digital assistant equipment. A timer interrupt is set up so that transmission may be possible after fixed time amount to the personal digital assistant equipment made to stand by by ST22, and it returns to ST11. This timer generates a timer interrupt after the setup time, and shifts to a timer interrupt.

[0055] Next, in order to look for other personal digital assistant equipments, it asks by ST11 and a signal is transmitted. When the personal digital assistant equipment which communicates after the personal digital assistant equipment made to stand by is found, POS terminal 3 forbids the timer interrupt to the personal digital assistant equipment which is standing by by ST17, and should just cancel prohibition of the timer interrupt to standby personal digital assistant equipment after communication link termination of ST19.

[0056] Thereby, while wireless POS terminal 3 and personal digital assistant equipment are communicating, transmission and reception with waiting personal digital assistant equipment stop occurring, and wireless POS terminal 3 can communicate efficiently.

[0057] If a timer interrupt occurs while wireless POS terminal 3 is looking for personal digital assistant equipment, a transmitted power demand will be transmitted to addressing to personal digital assistant equipment waiting at ST23. Since personal digital assistant equipment has already made transmitted power min, it does not need to send the instruction which makes transmitted power min here. In addition, it is satisfactory, even if it includes the instruction which makes transmitted power min and transmits.

[0058] If a transmitted power demand is received by ST41, waiting personal digital assistant equipment will transmit a transmitted power value by ST42, and will return to ST37. On the other hand, wireless POS terminal 3 receives a transmitted power value by ST24, and a RSSI value also reads it at this time. And distance is presumed from a transmitted power value and a RSSI value by ST25. The presumed approach of distance is the same as the time of ST15. And when distance is judged to be in a threshold by ST26, a communication link will be performed to ST17 with return and personal digital assistant equipment. Moreover, when distance is judged to be outside a threshold by ST26, it will return to ST20 and it will be judged whether personal digital assistant equipment is standby within the limits.

[0059] Those who own personal digital assistant equipment by doing in this way are doing waiting for settlement of accounts in front of POS terminal 3, personal digital assistant equipment is in a standby condition, and when the synchronization of transceiver timing with POS terminal 3 could

be taken, it becomes the man's sequence and a POS terminal is approached, POS terminal 3 and radio can be performed immediately.

[0060] Moreover, in POS terminal 3, connection of the personal digital assistant equipment with which a POS terminal communicates can be made a positive thing by performing that display which may communicate to personal digital assistant equipment at the time of communication link initiation with personal digital assistant equipment, and making the owner of personal digital assistant equipment judge communicative propriety.

[0061] Moreover, since it becomes the increment in power consumption in personal digital assistant equipment to always make it a receive state, Usually, if it is made to carry out actuation in which those who suspend the current supply of the wireless section and own personal digital assistant equipment perform current supply of the wireless section near the POS terminal The number of personal digital assistant equipment which a POS terminal asks and receives the response to a signal decreases, and connection can be more certainly made with target personal digital assistant equipment.

[0062] In addition, in the gestalt of this operation, although the case where an inquiry signal is transmitted from a POS terminal is described, it may not necessarily limit to this, and you may transmit from personal digital assistant equipment. That is, if those who own personal digital assistant equipment become the sequence which communicates with a POS terminal, an inquiry signal will be transmitted to a POS terminal by operating personal digital assistant equipment. If an inquiry signal is received, a POS terminal answers and should just transmit the demand which makes min the transmitting output of personal digital assistant equipment.

[0063] Moreover, although the POS terminal received the transmitted power from personal digital assistant equipment and distance with personal digital assistant equipment was presumed in the gestalt of this operation Furthermore, the information which includes transmitted power information in personal digital assistant equipment from a POS terminal is transmitted. Personal digital assistant equipment receives that information, and personal digital assistant equipment presumes distance with a POS terminal from the received power and transmitted power information at this time, transmit this presumed distance to a POS terminal, and it sets to a POS terminal. The system configuration in the gestalt of this (gestalt of the 2nd operation) operation that may judge whether it is the distance which performs a communication link from the distance which self presumed, and the distance received from personal digital assistant equipment is the same as the gestalt of the 1st operation mentioned above. A different point from the gestalt of the 1st operation is a point that personal digital assistant equipment transmits a reference signal. A reference signal is a radio signal which transmits with the same transmitted power, even if it consists of data including the information which can identify that it is the identification information and the reference signal of equipment which transmit and is transmitted from which personal digital assistant equipment. For example, what is necessary is just to specify the transmitted power of a reference signal as 0dBm beforehand.

[0064] Although the hardware configuration of a wireless POS terminal is the same as the gestalt of the 1st operation, the means of distance presumption differ. The received data which turned into digital data by the receive section 103 and the received-data transducer 104 when the antenna 101 received the radio signal which is a reference signal are transmitted to the received-data acquisition means 122, if it judges that it is a reference signal in this received-data acquisition means 122, it will tell having received the reference signal to the distance presumption means 123, and this distance presumption means 123 will acquire the transmitted power corresponding to a reference signal.

[0065] When having received the reference signal, the received-power acquisition means 121 acquires received power from a receive section 103 through the receiving signal strength display 105. The received power acquired with the received-power acquisition means 121 is told to the distance presumption means 123. The distance presumption means 123 presumes distance with the personal digital assistant equipment which transmitted the reference signal from the received power when receiving the transmitted power of a reference signal, and a reference signal.

[0066] Although the hardware configuration of personal digital assistant equipment is the same as the gestalt of the 1st operation, a different point is a point of transmitting a reference signal.

When transmitting a reference signal, in order to transmit with the transmitted power corresponding to a reference signal from the transmitted power setting means 225, the transmitted power of the transmitting section 207 is set up through the transmitted power control section 209.

[0067] Telling that it is a reference signal to the transmitted power acquisition means 226 from the transmitted power setting means 225, the transmitted power acquisition means 226 tells transmitting a reference signal to the transmit data creation means 224. The transmit data creation means 224 creates reference signal data including the information which can identify that it is the identification information and the reference signal of a local station. Reference signal data are transmitted as a reference signal from an antenna 201 through the transmit data transducer 208 and the transmitting section 207.

[0068] Drawing 8 is the flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom wireless POS terminal 3 communicates, and personal digital assistant equipment, and first, wireless POS terminal 3 asks it by ST51, and it transmits a signal to personal digital assistant equipment. An inquiry signal is the inquiry which was made to contain the identification information of a local station and was addressed to many and unspecified personal digital assistant equipments. When personal digital assistant equipment does not exist in a perimeter, those without a response are judged in the judgment of the response existence in ST52, and it returns to transmission of the inquiry signal of ST51.

[0069] On the other hand, personal digital assistant equipment is in a receiving waiting state by ST71, and if it asks by ST72 and reception of a signal is judged, the response in which the identification information of wireless POS terminal 3 and the identification information of a local station which have asked by ST73 were included will be transmitted. Personal digital assistant equipment takes the synchronization of transceiver timing with a wireless POS terminal, when an inquiry signal is received, and it establishes a communication link. In order to take the synchronization of transceiver timing depending on the correspondence procedure used at this time, the exchange of a radio signal may occur further.

[0070] Wireless POS terminal 3 will transmit a reference signal Request to Send to addressing to personal digital assistant equipment which had the response by ST53, if those with a response are judged by ST52. The reference signal contains the identification information which tells that they are the identification information of a transmission place, the identification information of a transmitting agency, and a reference signal, and specifies transmitted power beforehand. If a reference signal Request to Send is received by ST74, the radio control section 206 will set it as the transmitted power control section 209 by ST75, and personal digital assistant equipment will set up the transmitting section 207 so that it may transmit with the transmitted power specified as transmitted power of a reference signal.

[0071] Then, a reference signal is transmitted by ST76. Wireless POS terminal 3 is in the receiving waiting of a reference signal, and it judges whether the reference signal was receivable by ST54. Even if it passes beyond fixed time amount, when a reference signal is unreceivable, it judges that it is not approaching within limits with which the personal digital assistant equipment which transmitted the reference signal demand communicates, and returns to ST51.

[0072] When receiving a reference signal, a RSSI value is inputted into the received-power acquisition means 221 from the receiving signal strength display 205, received power is acquired, and it is told to the distance presumption means 223. Since the transmitted power of a reference signal is known beforehand, distance is presumed by ST55 from the transmitted power of a reference signal, and the received power of the received personal digital assistant equipment.

[0073] If transmitted power of a reference signal is set to  $P_t$  (dBm), power which wireless POS terminal 3 receives is set to  $P_i$  (dBm) and wavelength of a wireless electric wave is set to  $\lambda$  (m), the distance  $D$  of personal digital assistant equipment and wireless POS terminal 3 (m) is computable by using (1) type mentioned above.

[0074] In this way, presumption of distance judges whether the distance presumed by ST56 is in a threshold. If the distance of wireless POS terminal 3 and personal digital assistant equipment is

in a threshold, the timer interruption for transmitting to the personal digital assistant equipment which is standing by by ST57 will be forbidden. Moreover, if the distance of wireless POS terminal 3 and personal digital assistant equipment is over the threshold, processing will shift to C1 of drawing 9.

[0075] Then, wireless POS terminal 3 transmits the communication link start signal which tells communication link initiation by ST58 to personal digital assistant equipment, and communicates by ST59. On the other hand, personal digital assistant equipment starts a communication link by ST78, when it judges whether it is communication link initiation by ST77 and a communication link start signal is received. Moreover, when not receiving a communication link start signal, processing shifts to D1 of drawing 9.

[0076] Thus, wireless POS terminal 3 communicates by ST59, and personal digital assistant equipment communicates by ST78, and it processes informational exchange etc.

[0077] Like the personal digital assistant equipment 2 which those who have stood in a line by turn waiting in drawing 1 own, the communication link with personal digital assistant equipment is kept established about the personal digital assistant equipment which will approach wireless POS terminal 3 immediately.

[0078] If it is received by POS terminal 3 and the reference signal transmitted by ST76 from personal digital assistant equipment is judged that distance is further than a threshold by ST56, it will shift to C1 of drawing 9, and will judge whether it goes into standby within the limits whose distance is the 2nd threshold by ST60.

[0079] personal digital assistant equipment -- standby -- when it is judged that it is out of range, POS terminal 3 judges that the personal digital assistant equipment and communication link are not performed, and returns to ST51. In order not to have reception of a communication link start signal at ST77 even if personal digital assistant equipment carries out fixed time amount progress, and not to receive a standby signal by ST79 at this time, either, it returns to ST71.

[0080] When it is judged that wireless POS terminal 3 exists in personal digital assistant equipment's standby within the limits, a standby signal is transmitted to personal digital assistant equipment by ST61. Personal digital assistant equipment will serve as waiting for reception, holding the synchronization of transceiver timing by ST80, if a standby signal is received by ST79.

[0081] After transmitting a standby signal, wireless POS terminal 3 communicates periodically, in order to consider the check of distance as synchronous maintenance of transceiver timing with personal digital assistant equipment. A timer interrupt is set up so that transmission may be possible after fixed time amount to the personal digital assistant equipment made to stand by by ST62, and it returns to ST61. This timer generates a timer interrupt after the setup time, and shifts to a timer interrupt.

[0082] Next, in order to look for other personal digital assistant equipments, it asks by ST51 and a signal is transmitted. When the personal digital assistant equipment which communicates after the personal digital assistant equipment made to stand by is found, POS terminal 3 forbids the timer interrupt to the personal digital assistant equipment which is standing by by ST57, and should just cancel prohibition of the timer interrupt to standby personal digital assistant equipment after communication link termination of ST59.

[0083] Thereby, while wireless POS terminal 3 and personal digital assistant equipment are communicating, transmission and reception with waiting personal digital assistant equipment stop occurring, and wireless POS terminal 3 can communicate efficiently.

[0084] If a timer interrupt occurs while wireless POS terminal 3 is looking for personal digital assistant equipment, a reference signal Request to Send will be transmitted to addressing to personal digital assistant equipment waiting at ST63. If a reference signal Request to Send is received by ST81, personal digital assistant equipment will transmit a reference signal by ST82, and will return to ST77.

[0085] Since waiting personal digital assistant equipment is set as the transmitted power which already transmits a reference signal, after receiving a reference signal Request to Send, it is not necessary to set up transmitted power but, and it is satisfactory even if it resets to the

transmitted power which transmits a reference signal.

[0086] Wireless POS terminal 3 also performs acquisition of received power, when receiving a reference signal by ST64. And distance is presumed from transmitted power and received power by ST65. The presumed approach of distance is the same as the time of ST55. And when distance is judged to be in a threshold by ST66, a communication link will be performed to ST57 with return and personal digital assistant equipment. Moreover, when distance is judged to be outside a threshold by ST66, it will return to ST60 and it will be judged whether personal digital assistant equipment is standby within the limits.

[0087] Those who own personal digital assistant equipment by doing in this way are doing waiting for settlement of accounts in front of wireless POS terminal 3, personal digital assistant equipment is in a standby condition, and when the synchronization of transceiver timing with wireless POS terminal 3 could be taken, it becomes the man's sequence and a wireless POS terminal is approached, the POS terminal 3 and radio can be performed immediately.

[0088] In addition, an inquiry signal may be transmitted from personal digital assistant equipment. That is, if those who own personal digital assistant equipment become the sequence which communicates with a wireless POS terminal, an inquiry signal will be transmitted to a POS terminal by operating personal digital assistant equipment. If an inquiry signal is received, a wireless POS terminal answers and should just transmit the Request to Send of a reference signal to personal digital assistant equipment.

[0089] In addition, with the gestalt of each operation mentioned above, although the wireless POS terminal to be used is made into one set, it may not necessarily limit to this, and two or more sets may be used. What is necessary is just to set the POS terminal to the inquiry signal of other POS terminals so that it may not answer when there are two or more wireless POS terminals. That is, if the identification information of a POS terminal gets down that it is sudden at the time of installation and the recognition signal of a POS terminal is included in an inquiry signal, it will become possible to make it not answer the inquiry signal of other POS terminals. Thereby, the unnecessary communication link between POS terminals can be lost.

[0090] Moreover, multiple-times transmission of the reply signal which made min transmitted power transmitted to a POS terminal from personal digital assistant equipment in the gestalt of the 1st operation, and the reference signal transmitted to a POS terminal from personal digital assistant equipment in the gestalt of the 2nd operation is carried out, and a POS terminal may receive this signal, a RSSI value may be read for every reception, and you may judge whether it is the distance within a threshold from the result of multiple times.

[0091] That is, as the magnitude of attenuation of power [ in / for  $((P_i - P_t) \text{ dB})$  of (1) type mentioned above / the wireless section ], when relation with distance is shown, it comes to be shown in drawing 10 . Even if, as for this relation, it changes about 10dB of magnitude of attenuation near the POS terminal, there is no change with a big distance, but the location which separated at least 3m from the POS terminal shows that distance changes 1m or more, if about 5dB of magnitude of attenuation changes. From this, when dispersion in the distance found from the reading result of the transmitting output value of multiple times and a RSSI value is small, you may judge that it is in communication link within the limits.

[0092] In addition, in the gestalt of each operation mentioned above, although what used the 1st radio communication equipment as personal digital assistant equipment, used the 2nd radio communication equipment as the wireless POS terminal, and applied this invention to the wireless POS system was described, of course, it is not necessarily what is limited to this.

[0093]

[Effect of the Invention] As explained in full detail above, when according to invention according to claim 1 to 8 a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments and performs radio, the radio approach that radio can be performed can be offered without applying troublesome time and effort.

[0094] Moreover, when according to invention according to claim 9 to 12 a radio communication equipment specifies the radio communication equipment which performs a communication link from many and unspecified radio communication equipments and performs radio, the radio

communications system which can perform radio can be offered, without applying troublesome time and effort.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the system configuration concerning the gestalt of operation of the 1st of this invention.

[Drawing 2] The block diagram showing the configuration of the wireless POS terminal in the gestalt of this operation.

[Drawing 3] The block diagram showing the configuration of the radio control section of the wireless POS terminal in drawing 2 .

[Drawing 4] The block diagram showing the configuration of the personal digital assistant equipment in the gestalt of this operation.

[Drawing 5] The block diagram showing the configuration of the radio control section of the personal digital assistant equipment in drawing 4 .

[Drawing 6] The flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom a wireless POS terminal communicates in the gestalt of this operation, and personal digital assistant equipment.

[Drawing 7] The flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom a wireless POS terminal communicates in the gestalt of this operation, and personal digital assistant equipment.

[Drawing 8] The flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom a wireless POS terminal communicates in the gestalt of other operations of this invention, and personal digital assistant equipment.

[Drawing 9] The flow chart showing an exchange of the signal of the wireless POS terminal when determining the personal digital assistant equipment which serves as a partner with whom a wireless POS terminal communicates in the gestalt of this operation, and personal digital assistant equipment.

[Drawing 10] The graph which shows the relation between the magnitude of attenuation of power, and distance.

[Description of Notations]

1 Two -- Personal digital assistant equipment (the 1st radio communication equipment)

3 -- Wireless POS terminal (the 2nd radio communication equipment)

100,200 -- Wireless section

106,206 -- Radio control section

121,221 -- Received-power acquisition means



- 122,222 -- Received-data acquisition means  
 123,223 -- Distance presumption means  
 124,224 -- Transmit data creation means  
 125,225 -- Transmitted power setting means  
 126,226 -- Transmitted power acquisition means

[Translation done.]

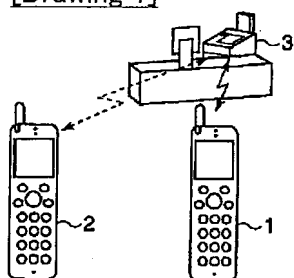
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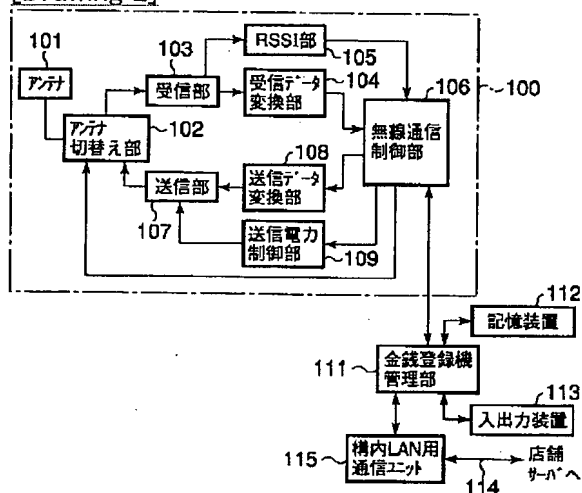
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DRAWINGS

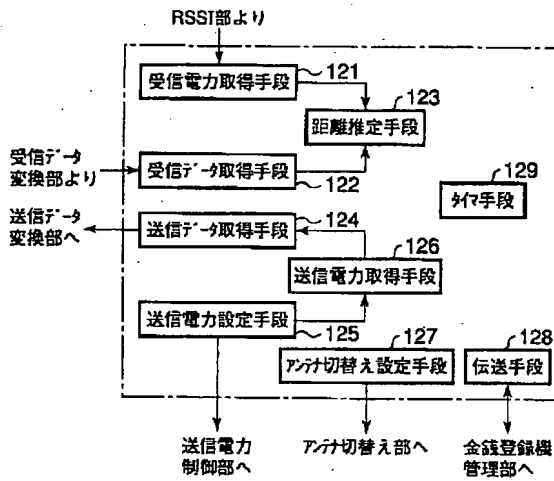
[Drawing 1]



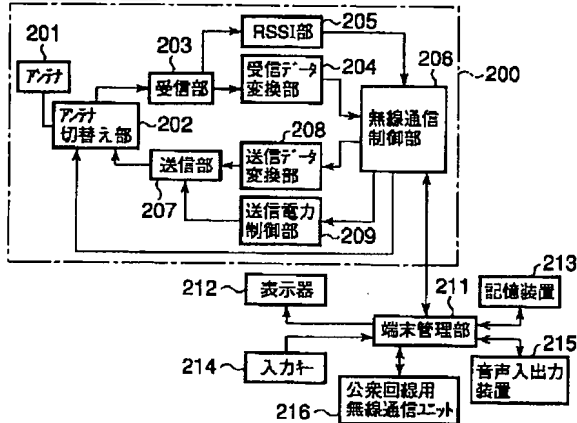
[Drawing 2]



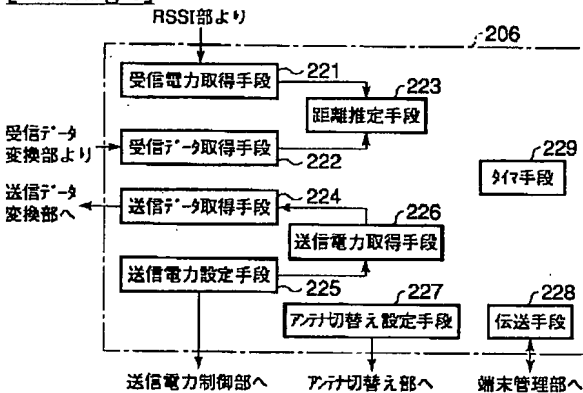
[Drawing 3]



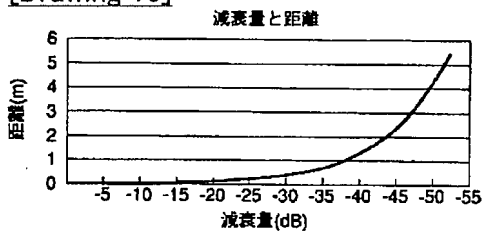
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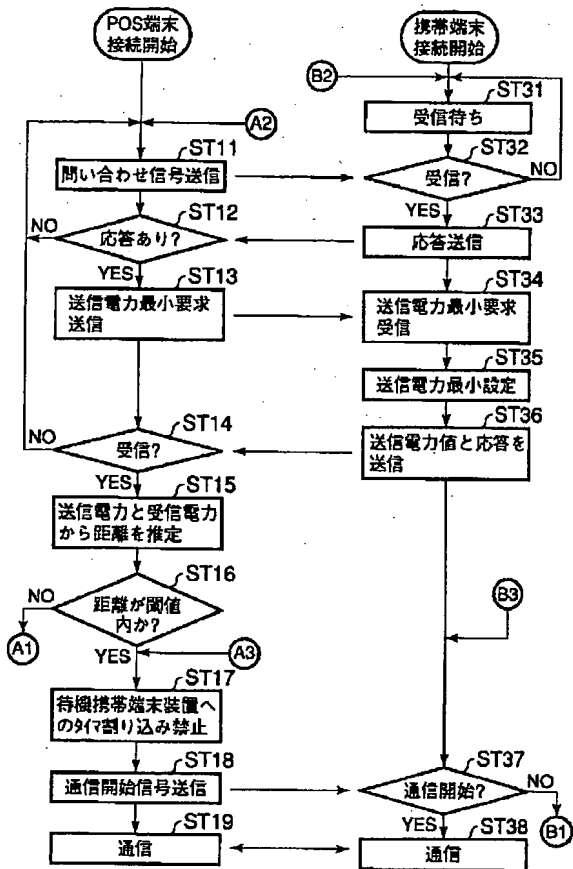
[Drawing 5]



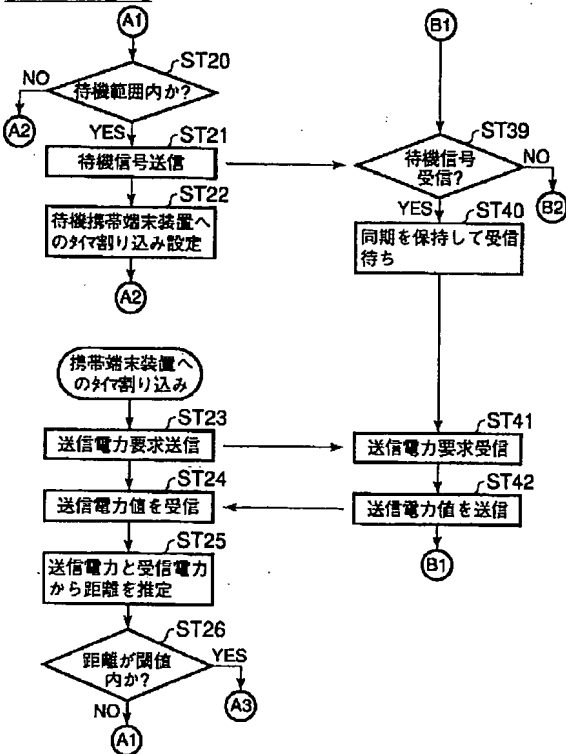
[Drawing 10]



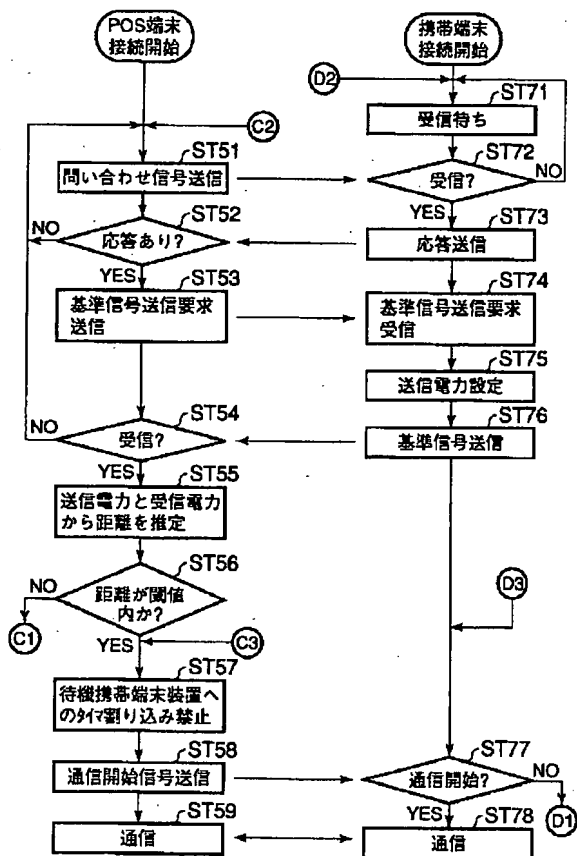
[Drawing 6]



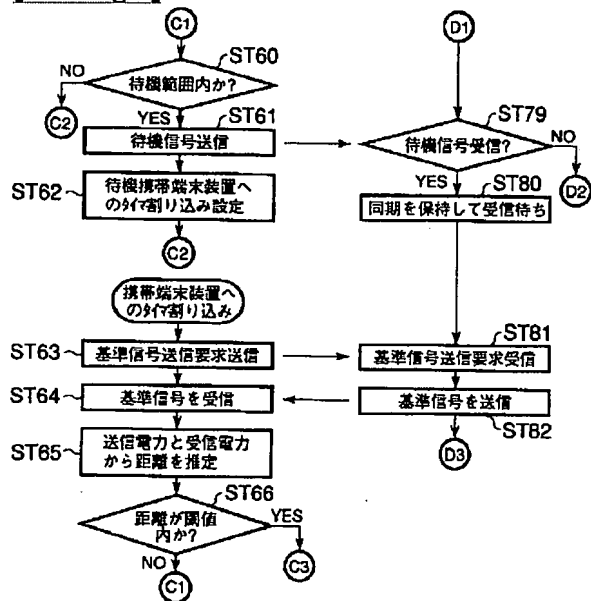
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]

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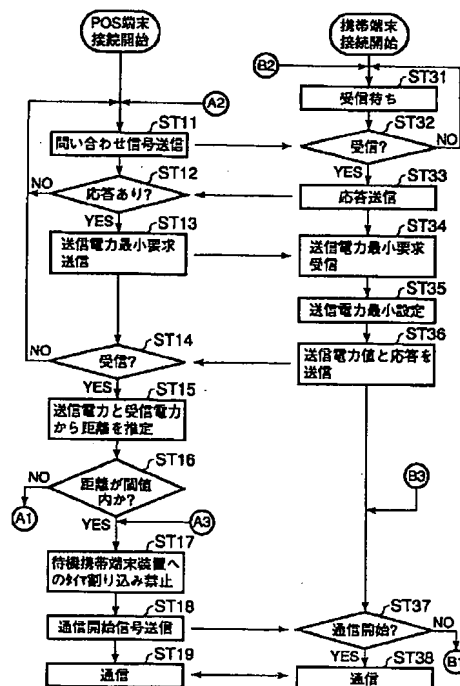
EE10 EE22 GG08 HH22

(54) 【発明の名称】 無線通信方法及び無線通信システム

(57) 【要約】

【課題】 無線通信装置が通信を行う無線通信装置を特定して無線通信を行う場合に、面倒な手間をかけることなく無線通信を行う。

【解決手段】 無線POS端末装置は携帯端末装置に問い合わせ信号を送信し、携帯端末装置はこれを受信すると応答を返し、無線POS端末装置は携帯端末装置に送信電力最小要求を送信する。携帯端末装置はこの要求を受信すると送信電力を最小に設定し送信電力値と応答をPOS端末装置に送信する。これを受信したPOS端末装置は受信した信号に含まれている送信電力値と実際に受信した受信電力とから携帯端末装置との距離を推定し、その距離が閾値内であれば携帯端末装置と通信を開始する。



## 【特許請求の範囲】

【請求項1】 第1の無線通信装置から第2の無線通信装置に送信電力情報を備えた無線信号を送信し、前記第2の無線通信装置は、前記無線信号を受信して受信電力情報を取得し、この取得した受信電力情報と前記無線信号の送信電力情報とから前記第1の無線通信装置との距離を算出し、この算出した距離が所定値内であれば前記第1の無線通信装置と無線通信を行うことを特徴とする無線通信方法。

【請求項2】 第1の無線通信装置は、無線信号を送信するときに設定した送信電力情報をその無線信号に含ませて送信し、前記第2の無線通信装置は、取得した受信電力情報と前記無線信号に含まれた送信電力情報とから前記第1の無線通信装置との距離を算出することを特徴とする請求項1記載の無線通信方法。

【請求項3】 第2の無線通信装置は、送信電力の指定情報を含む無線信号を第1の無線通信装置に送信し、前記第1の無線通信装置は、前記無線信号に含まれる送信電力の指定情報に基づいて送信電力を設定し、この送信電力を送信電力情報として無線信号に含ませて前記第2の無線通信装置に送信することを特徴とする請求項2記載の無線通信方法。

【請求項4】 第2の無線通信装置から第1の無線通信装置に送信する送信電力の指定情報は、送信電力を最小にする指定情報であることを特徴とする請求項3記載の無線通信方法。

【請求項5】 第1又は第2の無線通信装置から第2又は第1の無線通信装置に問い合わせ信号を送信すると共に、前記第2又は第1の無線通信装置から前記第1又は第2の無線通信装置に問い合わせ信号に対する応答信号を送信して相手を確認した後、前記第2の無線通信装置は送信電力の指定情報を含む無線信号を前記第1の無線通信装置に送信することを特徴とする請求項3記載の無線通信方法。

【請求項6】 第1の無線通信装置は、送信電力が予め固定された基準信号を無線信号として送信し、前記第2の無線通信装置は、取得した受信電力情報と前記基準信号の送信電力とから前記第1の無線通信装置との距離を算出することを特徴とする請求項1記載の無線通信方法。

【請求項7】 第1又は第2の無線通信装置から第2又は第1の無線通信装置に問い合わせ信号を送信すると共に、前記第2又は第1の無線通信装置から前記第1又は第2の無線通信装置に問い合わせ信号に対する応答信号を送信して相手を確認した後、前記第2の無線通信装置は前記第1の無線通信装置に基準信号の要求信号を送信し、前記第1の無線通信装置は要求信号に基づいて基準信号を送信することを特徴とする請求項6記載の無線通信方法。

【請求項8】 第1の無線通信装置を携帯端末装置、第

2の無線通信装置を親局とし、前記親局は算出した携帯端末装置との距離が所定値を越えているときには、その携帯端末装置に待機信号を送信し、前記携帯端末装置は、待機信号を受信すると前記親局との送受信タイミングの同期を保持しながら受信待機状態になることを特徴とする請求項5又は7記載の無線通信方法。

【請求項9】 第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、前記第2の無線通信装置は、前記第1の無線通信装置から送信される送信電力情報を含む無線信号を受信しこの無線信号の受信電力を取得する取得手段と、この取得手段が取得した受信電力と前記無線信号に含まれる送信電力情報とから前記第1の無線通信装置との距離を算出する算出手段と、この算出手段が算出した距離が所定値内のとき前記第1の無線通信装置と無線通信を行う無線通信手段とを備えたことを特徴とする無線通信システム。

【請求項10】 第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、

前記第1の無線通信装置は、自己の送信電力を設定する設定手段と、この設定手段が設定した送信電力情報を含む無線信号を送信する送信手段とを備えたことを特徴とする請求項9記載の無線通信システム。

【請求項11】 第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、

前記第2の無線通信装置は、前記第1の無線通信装置から送信される基準信号を受信しこの基準信号の受信電力を取得する取得手段と、この取得手段が取得した受信電力と前記基準信号に対して予め設定された送信電力情報とから前記第1の無線通信装置との距離を算出する算出手段と、この算出手段が算出した距離が所定値内のとき前記第1の無線通信装置と無線通信を行う無線通信手段とを備えたことを特徴とする無線通信システム。

【請求項12】 第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、

前記第1の無線通信装置は、前記第2の無線通信装置に送信する基準信号の送信電力を予め設定された送信電力に設定する設定手段と、この設定手段が設定した送信電力で基準信号を送信する送信手段とを備えたことを特徴とする請求項11記載の無線通信システム。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、無線通信装置が不特定多数の無線通信装置から通信を行う無線通信装置を特定して無線通信を行う無線通信方法及び無線通信システムに関する。

## 【0002】

【従来の技術】無線通信装置が不特定多数の無線通信装

置から通信を行う無線通信装置を特定して無線通信を行うシステムとしては、例えば、特開平11-184947号公報に記載されたものが知られている。これは、電子マネーを保有するPHS端末と、店舗の現金支払い場所に配置されるPOS端末装置の機能にPHS端末の基地局の機能を持たせた電子バリュー受け取り装置が無線通信を行うことにより電子決済を行うようになっている。PHS端末と電子バリュー受け取り装置との通信リンクを確立する手順として、電子バリュー受け取り装置に接続された番号入力キーボードから利用者が利用するPHS端末を特定するための番号を入力し、電子バリュー受け取り装置がその番号で特定されるPHS端末に対する発呼を行い、電子決済を行うPHS端末を特定するようになっている。

#### 【0003】

【発明が解決しようとする課題】このシステムでは、電子決済を行う場合、客は電子決済を行う前に自分の持っているPHS端末を特定するために番号入力キーボードから番号を入力しなければならず、このため手間がかかり電子バリュー受け取り装置での精算に時間がかかるという問題があった。また、客はPHSを特定するための番号を覚えなければならない面倒があり、番号を忘れることが有ると電子決済ができなくなるという問題があった。

【0004】そこで、請求項1乃至8記載の発明は、無線通信装置が不特定多数の無線通信装置から通信を行う無線通信装置を特定して無線通信を行う場合に、面倒な手間をかけることなく無線通信を行うことができる無線通信方法を提供する。また、請求項9乃至12記載の発明は、無線通信装置が不特定多数の無線通信装置から通信を行う無線通信装置を特定して無線通信を行う場合に、面倒な手間をかけることなく無線通信を行うことができる無線通信システムを提供する。

#### 【0005】

【課題を解決するための手段】請求項1記載の発明は、第1の無線通信装置から第2の無線通信装置に送信電力情報を備えた無線信号を送信し、第2の無線通信装置は、無線信号を受信して受信電力情報を取得し、この取得した受信電力情報と無線信号の送信電力情報とから第1の無線通信装置との距離を算出し、この算出した距離が所定値内であれば第1の無線通信装置と無線通信を行う無線通信方法にある。

【0006】請求項2記載の発明は、請求項1記載の無線通信方法において、第1の無線通信装置は、無線信号を送信するときに設定した送信電力情報をその無線信号に含ませて送信し、第2の無線通信装置は、取得した受信電力情報と無線信号に含まれた送信電力情報とから第1の無線通信装置との距離を算出することにある。

【0007】請求項3記載の発明は、請求項2記載の無線通信方法において、第2の無線通信装置は、送信電力

の指定情報を含む無線信号を第1の無線通信装置に送信し、第1の無線通信装置は、無線信号に含まれる送信電力の指定情報に基づいて送信電力を設定し、この送信電力を送信電力情報として無線信号に含ませて第2の無線通信装置に送信することにある。

【0008】請求項4記載の発明は、請求項3記載の無線通信方法において、第2の無線通信装置から第1の無線通信装置に送信する送信電力の指定情報は、送信電力を最小にする指定情報としたことにある。

【0009】請求項5記載の発明は、請求項3記載の無線通信方法において、第1又は第2の無線通信装置から第2又は第1の無線通信装置に問い合わせ信号を送信すると共に、第2又は第1の無線通信装置から第1又は第2の無線通信装置に問い合わせ信号に対する応答信号を送信して相手を確認した後、第2の無線通信装置は送信電力の指定情報を含む無線信号を第1の無線通信装置に送信することにある。

【0010】請求項6記載の発明は、請求項1記載の無線通信方法において、第1の無線通信装置は、送信電力が予め固定された基準信号を無線信号として送信し、第2の無線通信装置は、取得した受信電力情報と基準信号の送信電力とから第1の無線通信装置との距離を算出することにある。

【0011】請求項7記載の発明は、請求項6記載の無線通信方法において、第1又は第2の無線通信装置から第2又は第1の無線通信装置に問い合わせ信号を送信すると共に、第2又は第1の無線通信装置から第1又は第2の無線通信装置に問い合わせ信号に対する応答信号を送信して相手を確認した後、第2の無線通信装置は第1の無線通信装置に基準信号の要求信号を送信し、第1の無線通信装置は要求信号に基づいて基準信号を送信することにある。

【0012】請求項8記載の発明は、請求項5又は7記載の無線通信方法において、第1の無線通信装置を携帯端末装置、第2の無線通信装置を親局とし、親局は算出した携帯端末装置との距離が所定値を越えているときには、その携帯端末装置に待機信号を送信し、携帯端末装置は、待機信号を受信すると親局との送受信タイミングの同期を保持しながら受信待機状態になることにある。

【0013】請求項9記載の発明は、第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、第2の無線通信装置は、第1の無線通信装置から送信される送信電力情報を含む無線信号を受信しこの無線信号の受信電力を取得する取得手段と、この取得手段が取得した受信電力と無線信号に含まれる送信電力情報とから第1の無線通信装置との距離を算出する算出手段と、この算出手段が算出した距離が所定値内のとき第1の無線通信装置と無線通信を行う無線通信手段とを備えたことにある。

【0014】請求項10記載の発明は、請求項9記載の

無線通信システムにおいて、第1の無線通信装置は、自己の送信電力を設定する設定手段と、この設定手段が設定した送信電力情報を含む無線信号を送信する送信手段とを備えたことにある。

【0015】請求項11記載の発明は、第1の無線通信装置と第2の無線通信装置との間で無線通信を行う無線通信システムにおいて、第2の無線通信装置は、第1の無線通信装置から送信される基準信号を受信しこの基準信号の受信電力を取得する取得手段と、この取得手段が取得した受信電力と基準信号に対して予め設定された送信電力情報とから第1の無線通信装置との距離を算出する算出手段と、この算出手段が算出した距離が所定値内のとき第1の無線通信装置と無線通信を行う無線通信手段とを備えたことにある。

【0016】請求項12記載の発明は、請求項11記載の無線通信システムにおいて、第1の無線通信装置は、第2の無線通信装置に送信する基準信号の送信電力を予め設定された送信電力に設定する設定手段と、この設定手段が設定した送信電力で基準信号を送信する送信手段とを備えたことにある。

【0017】

【発明の実施の形態】以下、本発明の実施の形態を、図面を参照して説明する。

（第1の実施の形態）図1は無線通信システムである無線POSシステムの構成を示す図で、1及び2は第1の無線通信装置としての携帯端末装置、3は第2の無線通信装置を備えた無線POS（販売時点情報管理）端末装置である。

【0018】前記無線POS端末装置3は、店舗内の支払い場所である精算部に設置されるもので、顧客の購入した商品を登録し、顧客からの支払いを受けて精算処理を行い、レシートを発行するようになっている。前記携帯端末装置1、2は、モバイルキャッシュのような現金と同様に使用できる電子化されたお金がデータとして記憶されており、商品の登録時に前記無線POS端末装置3と通信を行うことで電子化されたお金を使用して支払いができるようになっている。

【0019】前記無線POS端末装置3は、図2に示すように、前記携帯端末装置1、2と無線通信を行う第2の無線通信装置を構成する無線部100、全体の動作管理を行う金銭登録機管理部111、自己の識別情報、POSデータの一部、装置を運用するためのデータ等を記憶する記憶装置112、キーボードやスキャナ等の入力装置とディスプレイやプリンタを有するレシート発行機等の出力装置を含む入出力装置113、構内LAN114を介して店舗サーバと通信を行う構内LAN用通信ユニット115を備えている。

【0020】前記無線部100は、アンテナ101、アンテナ切替え部102、受信部103、この受信部103が受信した無線信号を復調しデジタルデータに変換す

る受信データ変換部104、前記受信部103が受信した無線信号のRSSI値を出力する受信信号強度表示（RSSI）部105、無線通信制御部106、送信部107、デジタルデータを変調して送信信号に変換し前記送信部107に出力する送信データ変換部108及び前記送信部107の送信電力を制御する送信電力制御部109によって構成されている。

【0021】前記無線通信制御部106は、図3に示すように、前記受信信号強度表示部105からのRSSI値から受信電力値を取得する受信電力取得手段121、前記受信データ変換部104からのデジタルデータから伝送誤りの有無を判断したりプリアンプルや伝送誤り制御用の符号を取り除き受信データを取得することができ、また、デジタルデータの中に送信電力値が含まれている場合にその送信電力値を取得する受信データ取得手段122、前記受信電力取得手段121が取得した受信電力値と前記受信データ取得手段122が取得した送信電力値とから、前記携帯端末装置1又は2との距離を推定する距離推定手段123を設けている。

【0022】前記無線通信制御部106は、また、送信データを無線区間の伝送フォーマットに適するようにヘッダ情報や伝送誤り制御用の符号化を行って前記送信データ変換部108に出力する送信データ作成手段124、送信データを送信するときの送信電力値を設定して前記送信電力制御部109に出力する送信電力設定手段125、この送信電力設定手段125で設定した送信電力値を取得する送信電力取得手段126を設けている。なお、前記送信データ作成手段124は、前記送信電力取得手段126が取得した送信電力値を送信データに含ませることもできる。

【0023】前記無線通信制御部106は、さらに、前記アンテナ切替え部102のアンテナ切替えを設定するアンテナ切替え設定手段127、前記金銭登録機管理部111とのデータ伝送を行う伝送手段128を設けている。さらに、前記無線通信制御部106には、タイマ手段129が含まれており、設定した時間が経過した後に割込みが発生するようになっており、設定時間経過後の送信や受信待ち時間のタイムアウト等の処理に使用できるようになっている。

【0024】前記無線POS端末装置3において無線部100が起動すると、無線通信制御部106内のアンテナ切替え設定手段127が、アンテナ切替え部102をアンテナ101と受信部103が接続するように設定し、無線部100を受信待ち状態にする。

【0025】前記アンテナ101で無線信号が受信されると、この受信信号がアンテナ切替え部102を経由して受信部103に入力される。受信部103は、受信した信号を増幅するとともに周波数を低く変換する。受信データ変換部104は、受信部103からの信号を復調しデジタルデータに変換して無線通信制御部106の受



信データ取得手段122に出力する。受信信号強度表示部105は、受信部103の受信出力のRSSI値を無線通信制御部106の受信電力取得手段121に出力する。

【0026】そして、無線通信制御部106では、受信電力取得手段121がRSSI値から受信電力値を取得し、受信データ取得手段122がデジタルデータから送信電力値を取得し、距離推定手段123が受信電力値と送信電力値とから携帯端末装置との距離を推定する。例えば、携帯端末装置1を所有する人が精算を行う位置において、携帯端末装置2を所有する人がその後と並んでいるとすると、先ず、携帯端末装置1からの無線信号を受信してその携帯端末装置1との距離を推定することになる。無線通信制御部106は、受信したデータの内容に応じて、送信動作や伝送手段128から金銭登録機管理部111に受信データを伝送するなどの動作を行う。

【0027】また、無線通信制御部106において送信データが発生すると、送信電力設定手段125が送信データを送信するときの送信電力値を設定し、これにより、送信電力制御部109が設定された送信電力値に従って送信部107の送信電力を制御し送信部107の送信出力を設定値にする。送信電力取得手段126は送信電力設定手段125が設定した送信電力値を取得し、送信データ作成手段124は送信電力値を含ませてデジタルな送信データを作成し送信データ変換部108に出力する。

【0028】アンテナ切替え設定手段127はアンテナ切替え部102を制御してアンテナ101と送信部107を接続し、送信データ変換部108は作成されたデジタルな送信データを変調して送信部107に出力し、送信部107は変調された信号を無線周波数に変換し、設定された送信電力値で送信信号を出力する。送信信号はアンテナ切替え部102を経由してアンテナ101から無線信号として送信される。また、図示しないが、受信データ取得手段122で取得したデータを伝送手段128に伝送することも可能であり、伝送手段128から送信データ作成手段124へデータを伝送することも可能である。

【0029】前記携帯端末装置1及び2は、図4に示すように、前記無線POS端末装置3と無線通信を行う無線部200、全体の動作管理を行う端末管理部211、情報を表示する表示器212、端末の識別情報や電話番号やモバイルキャッシュ等の情報を記憶する記憶装置213、使用者が数字入力や発信操作に使用するキー等を設けた入力キー214、公衆回線を使用して相手と電話するとき使用する音声入出力装置215及び公衆回線の基地局と無線通信を行う公衆回線用無線通信ユニット216を備えている。

【0030】前記無線部200は、アンテナ201、アンテナ切替え部202、受信部203、この受信部20

3が出力した信号を復調しデジタルデータに変換する受信データ変換部204、前記受信部203が受信した無線信号のRSSI値を出力する受信信号強度表示(RSSI)部205、無線通信制御部206、送信部207、デジタルデータを変調して送信信号に変換し前記送信部207に出力する送信データ変換部208及び前記送信部207の送信電力を制御する送信電力制御部209によって構成されている。

【0031】前記無線通信制御部206は、図5に示すように、前記受信信号強度表示部205からのRSSI値から受信電力値を取得する受信電力取得手段221、前記受信データ変換部204からのデジタルデータから伝送誤りの有無を判断したりブリアンブルや伝送誤り制御用の符号を取り除き受信データを取得することができ、また、デジタルデータの中に送信電力値が含まれている場合にその送信電力値を取得する受信データ取得手段222、前記受信電力取得手段221が取得した受信電力値と前記受信データ取得手段222が取得した送信電力値とから、前記無線POS端末装置3との距離を推定する距離推定手段223を設けている。

【0032】前記無線通信制御部206は、また、送信データを無線区間の伝送フォーマットに適するようにヘッダ情報や伝送誤り制御用の符号化を行って前記送信データ変換部208に出力する送信データ作成手段224、送信データを送信するときの送信電力値を設定して前記送信電力制御部209に出力する送信電力設定手段225、この送信電力設定手段225で設定した送信電力値を取得する送信電力取得手段226を設けている。なお、前記送信データ作成手段224は、前記送信電力取得手段226が取得した送信電力値を送信データに含ませることもできる。

【0033】前記無線通信制御部206は、さらに、前記アンテナ切替え部202のアンテナ切替えを設定するアンテナ切替え設定手段227、前記端末管理部211とのデータ伝送を行う伝送手段228を設けている。さらに、前記無線通信制御部206には、タイマ手段229が含まれており、設定した時間が経過した後に割込みが発生するようになっており、設定時間経過後の送信や受信待ち時間のタイムアウト等の処理に使用するようにになっている。

【0034】前記携帯端末装置1又は2において無線部200が起動すると、無線通信制御部206内のアンテナ切替え設定手段227が、アンテナ切替え部202をアンテナ201と受信部203が接続するように設定し、無線部200を受信待ち状態にする。

【0035】前記アンテナ201で無線信号が受信されると、この受信信号がアンテナ切替え部202を経由して受信部203に入力される。受信部203は、受信した信号を増幅するとともに周波数を低く変換する。受信データ変換部204は、受信部203からの信号を復調

しデジタルデータに変換して無線通信制御部 206 の受信データ取得手段 222 に出力する。受信信号強度表示部 205 は、受信部 203 の受信出力の RSSI 値を無線通信制御部 206 の受信電力取得手段 221 に出力する。

【0036】そして、無線通信制御部 206 では、受信電力取得手段 221 が RSSI 値から受信電力値を取得し、受信データ取得手段 222 がデジタルデータから送信電力値を取得し、距離推定手段 223 が受信電力値と送信電力値とから無線 POS 端末装置 3 との距離を推定する。無線通信制御部 206 は、受信したデータの内容に応じて、送信動作や伝送手段 228 から端末管理部 211 に受信データを伝送するなどの動作を行う。

【0037】また、無線通信制御部 206 において送信データが発生すると、送信電力設定手段 225 が送信データを送信するときの送信電力値を設定し、これにより、送信電力制御部 209 が設定された送信電力値に従って送信部 207 の送信電力を制御し送信部 207 の送信出力を設定値にする。送信電力取得手段 226 は送信電力設定手段 225 が設定した送信電力値を取得し、送信データ作成手段 224 は送信電力値を含ませてデジタルな送信データを作成し送信データ変換部 208 に出力する。

【0038】アンテナ切替え設定手段 227 はアンテナ切替え部 202 を制御してアンテナ 201 と送信部 207 を接続し、送信データ変換部 208 は作成されたデジタルな送信データを変調して送信部 207 に出力し、送信部 207 は変調された信号を無線周波数に変換し、設定された送信電力値で送信信号を出力する。送信信号はアンテナ切替え部 202 を経由してアンテナ 201 から無線信号として送信される。また、図示しないが、受信データ取得手段 222 で取得したデータを伝送手段 228 に伝送することも可能であり、伝送手段 228 から送信データ作成手段 224 へデータを伝送することも可能である。

【0039】図 6 は無線 POS 端末装置 3 が通信する相手となる携帯端末装置を決定するときの無線 POS 端末装置と携帯端末装置との信号のやり取りを示す流れ図で、まず、無線 POS 端末装置 3 が、ST11 にて問い合わせ信号を携帯端末装置に送信する。問い合わせ信号は、自局の識別情報を含ませて不特定多数の携帯端末装置に宛てた問い合わせである。携帯端末装置が周囲に存在しない場合は、ST12 における応答有無の判定において応答無しが判定され、ST11 の問い合わせ信号の送信に戻る。

【0040】一方、携帯端末装置は、ST31 にて受信待ち状態にあり、ST32 にて問い合わせ信号の受信を判定すると、ST33 にて問い合わせをしてきた無線 POS 端末装置 3 の識別情報と自局の識別情報を含ませた応答を送信する。携帯端末装置は、問い合わせ信号を受

信したときに無線 POS 端末装置との送受信タイミングの同期を取り、通信リンクを確立する。このとき使用する通信方法によっては送受信タイミングの同期を取るためにさらに無線信号のやり取りが発生することがある。

【0041】無線 POS 端末装置 3 は、ST12 にて応答有りを判定すると、ST13 にて応答のあった携帯端末装置宛てに、送信電力を最小にする要求を送信する。携帯端末装置は、ST34 にて送信電力を最小にする要求を受信すると、ST35 にて送信電力設定手段 225 が送信電力制御部 209 に送信電力を最小にする命令を伝え、送信電力制御部 209 は送信部 207 の送信出力が最小になるように設定する。また、送信電力設定部 225 は、設定値を送信電力取得手段 226 に伝え、送信電力取得手段 226 は設定値から送信電力を取得し、この取得した送信電力値を送信データ作成手段 224 に伝える。

【0042】このように送信電力を最小にすることは、無線 POS 端末装置から離れている携帯端末装置との通信を避ける効果があるとともに、携帯端末装置が送信する情報を受信できる範囲を狭くして悪意のある傍受を減らすことができる。さらに、携帯端末装置の消費電力を抑える効果もある。

【0043】その後、携帯端末装置は、ST36 にて送信データ作成手段 224 が送信電力取得手段 226 から受取った送信電力値を含む応答を作成し送信する。無線 POS 端末装置 3 は、送信電力を最小にする要求を送信した後の応答を待っており、ST14 にて応答を受信したかを判定する。一定時間以上経過しても応答を受信できない場合は、送信電力を最小にする要求を送信した携帯端末装置が通信を行う範囲内に近づいていないと判断し、ST11 に戻る。

【0044】送信電力を最小にした携帯端末装置からの応答を受信すると、受信信号強度表示部 105 から RSSI 値が受信電力取得手段 121 に入力され、受信電力を取得し、距離推定手段 123 に伝えられる。また、受信した無線信号はデジタルデータとして受信データ取得手段 122 に入力され、受信データ取得手段 122 は受信したデータに含まれている携帯端末装置の送信電力を取得し、距離推定手段 123 に伝える。そして、ST15 にて受信した携帯端末装置の送信電力と受信電力とから距離を推定する。

【0045】携帯端末装置から送信される電力を  $P_t$  (dBm) とし、無線 POS 端末装置 3 が受信する電力を  $P_i$  (dBm) とし、無線電波の波長を  $\lambda$  (m) とすると、携帯端末装置と無線 POS 端末装置 3 との距離  $D$  (m) は、

$$D = \frac{\lambda}{4\pi \times 10^{(P_i - P_t)/20}} \quad \dots (1)$$

となる。例として、携帯端末装置から送信される電力を

0 dBm、無線POS端末装置が受信する電力を-30 dBmとし、無線周波数を2.45GHzとすると、携帯端末装置と無線POS端末装置3との距離は、0.308mと推定できる。また、上記(1)式を使用することにより、送信電力が異なる携帯端末装置が存在する場合でも距離の推定を行うことができる。

【0046】こうして距離の推定を行うと、続いて、ST16にて推定した距離が閾値内にあるかを判定する。スーパーマーケットとコンビニエンスストアでは、無線POS端末装置の配置や順番待ちの列が異なるため、無線POS端末装置の使用形態によって距離の閾値は異なる。例えば、スーパーマーケットでは、距離の閾値を0.5mとし、無線POS端末装置3と携帯端末装置との距離が閾値内であれば、ST17にて待機している携帯端末装置へ送信をするためのタイマ割込みを禁止する。また、無線POS端末装置3と携帯端末装置との距離が閾値を越えていれば、処理は図7のA1へ移行する。

【0047】その後、無線POS端末装置3は、ST18にて通信開始を知らせる通信開始信号を携帯端末装置に送信し、ST19にて通信を行う。一方、携帯端末装置は、ST37にて通信開始であるかを判定し、通信開始信号を受信した場合は、ST38にて通信を開始する。また、通信開始信号を受信しない場合は、処理は図7のB1へ移行する。

【0048】このようにして、無線POS端末装置3はST19にて通信を行い、携帯端末装置はST38にて通信を行い、情報の交換等の処理を行う。これにより、無線POS端末装置は複数の携帯端末装置の中から通信範囲にある1台の携帯端末装置を限定することができる。

【0049】図1において順番待ちで並んでいる人が所有している携帯端末装置2のように、直ぐに無線POS端末装置3に近づくであろう携帯端末装置については、距離が離れていると判断して通信を行わなくても、携帯端末装置との通信リンクは確立したままの方が効率がよい。

【0050】携帯端末装置は、問い合わせ信号を受信したときに無線POS端末装置3と送受信タイミングの同期を取り、通信リンクを確立しているが、携帯端末装置2のように直ぐに無線POS端末装置3に近づくであろう携帯端末装置については、通信リンクを確立した状態で待機させる。

【0051】携帯端末装置からST36にて送信された送信電力値と応答が、POS端末装置3で受信され、ST16にて距離が閾値よりも遠いと判断されると、図7のA1に移行し、ST20にて距離が第2の閾値である待機範囲内に入っているか否かを判定する。この場合の待機範囲は精算待ちで並んでいる距離と考えれば良く、例えば、POS端末装置3から1.5m以内とすれば良

い。距離の推定はST15の結果を用いれば良い。

【0052】携帯端末装置が待機範囲外であると判断された場合は、POS端末装置3はその携帯端末装置と通信を行わないと判断し、ST11に戻る。このとき、携帯端末装置は、一定時間が経過してもST37にて通信開始信号の受信がなく、ST39にて待機信号も受信しないため、ST31に戻る。

【0053】無線POS端末装置3が、携帯端末装置が待機範囲内に存在していることを判断した場合は、ST21にて携帯端末装置に待機信号を送信する。携帯端末装置はST39にて待機信号を受信すると、ST40にて送受信タイミングの同期を保持したまま受信待ちとなる。

【0054】無線POS端末装置3は、待機信号を送信した後、携帯端末装置との送受信タイミングの同期保持と距離の確認をするために定期的に通信を行う。ST22にて待機させた携帯端末装置に対して一定時間後に送信ができるようにタイマ割込みの設定を行い、ST11に戻る。このタイマは設定時間後にタイマ割込みを発生し、タイマ割込みに移行する。

【0055】次に、他の携帯端末装置を探すために、ST11にて問い合わせ信号の送信をする。POS端末装置3は、待機させた携帯端末装置よりも後に通信を行う携帯端末装置を見つけた場合は、ST17にて待機している携帯端末装置へのタイマ割込みを禁止し、ST19の通信終了後に、待機携帯端末装置へのタイマ割込み禁止を解除すればよい。

【0056】これにより、無線POS端末装置3と携帯端末装置が通信を行っているときに、無線POS端末装置3は待機中の携帯端末装置との送受信が発生しなくなり、効率よく通信を行うことができる。

【0057】無線POS端末装置3が携帯端末装置を探しているときに、タイマ割込みが発生すると、ST23にて待機中の携帯端末装置宛てに送信電力要求を送信する。携帯端末装置は、既に送信電力を最小にしているため、ここでは送信電力を最小にする命令を送る必要はない。なお、送信電力を最小にする命令を含ませて送信しても問題はない。

【0058】待機中の携帯端末装置は、ST41にて送信電力要求を受信すると、ST42にて送信電力値を送信し、ST37に戻る。一方、無線POS端末装置3は、ST24にて送信電力値を受信し、このときRSSI値も読込む。そして、ST25にて送信電力値とRSSI値とから距離を推定する。距離の推定方法はST15のときと同じである。そして、ST26にて距離が閾値内であると判断された場合は、ST17に戻り、携帯端末装置と通信を行うことになる。また、ST26にて距離が閾値外であると判断された場合は、ST20に戻って携帯端末装置が待機範囲内であるかを判断することになる。

【0059】このようにすることにより、携帯端末装置を所有する人がPOS端末装置3の前で精算待ちをしていて、携帯端末装置が待機状態にあり、POS端末装置3との送受信タイミングの同期が取れていれば、その人の順番になりPOS端末装置に近づいたとき、直ちにPOS端末装置3と無線通信を行うことができる。

【0060】また、POS端末装置3では携帯端末装置との通信開始時に携帯端末装置に通信を行っても良いかの表示を行い、携帯端末装置の所有者に通信の可否を判断させることにより、POS端末装置が通信を行う携帯端末装置の接続を確実なものにすることができる。

【0061】また、携帯端末装置において、常に受信状態にしておくことは消費電力の増加になるため、通常は無線部の電源供給を停止しておき、携帯端末装置を所有する人がPOS端末装置の近くで無線部の電源供給を行う操作をするようにしておけば、POS端末装置が問い合わせ信号に対する応答を受信する携帯端末装置数が少なくなり、より確実に目的の携帯端末装置と接続を行うことができる。

【0062】なお、この実施の形態においては、問い合わせ信号をPOS端末装置から送信する場合について述べたが必ずしもこれに限定するものではなく、携帯端末装置から送信してもよい。すなわち、携帯端末装置を所有している人がPOS端末装置と通信を行う順番になったら携帯端末装置を操作することにより、問い合わせ信号をPOS端末装置に送信する。POS端末装置は、問い合わせ信号を受信すると、応答をし、携帯端末装置の送信出力を最小にする要求を送信すればよい。

【0063】また、この実施の形態においては、携帯端末装置からの送信電力をPOS端末装置が受信して携帯端末装置との距離を推定したが、さらに、POS端末装置から携帯端末装置に送信電力情報を含む情報を送信し、携帯端末装置でその情報を受信し、このときの受信電力と送信電力情報から携帯端末装置がPOS端末装置との距離を推定し、この推定した距離をPOS端末装置に送信し、POS端末装置において、自己が推定した距離と携帯端末装置から受信した距離とから通信を行う距離か否かを判断してもよい。

(第2の実施の形態) この実施の形態におけるシステム構成は前述した第1の実施の形態と同じである。第1の実施の形態と異なる点は携帯端末装置が基準信号を送信する点である。基準信号は、送信を行う装置の識別情報と基準信号であることを識別できる情報を含むデータで構成され、どの携帯端末装置から送信されても同じ送信電力で送信を行う無線信号である。例えば、基準信号の送信電力を予め0dBmと規定しておけばよい。

【0064】無線POS端末装置のハードウェア構成も第1の実施の形態と同じであるが、距離推定の手段が異なる。基準信号である無線信号をアンテナ101で受信すると、受信部103と受信データ変換部104により

デジタルデータとなった受信データを受信データ取得手段122に伝え、この受信データ取得手段122において基準信号であると判断すると、基準信号を受信したことを距離推定手段123に伝え、この距離推定手段123は基準信号に対応する送信電力を取得する。

【0065】基準信号を受信しているとき、受信部103から受信信号強度表示部105を経て受信電力取得手段121が受信電力を取得する。受信電力取得手段121にて取得した受信電力を距離推定手段123に伝える。距離推定手段123は、基準信号の送信電力と基準信号を受信したときの受信電力から、基準信号を送信した携帯端末装置との距離を推定する。

【0066】携帯端末装置のハードウェア構成も第1の実施の形態と同じであるが、異なる点は基準信号を送信する点である。基準信号を送信するとき、送信電力設定手段225から基準信号に対応した送信電力で送信するため、送信電力制御部209を介して送信部207の送信電力を設定する。

【0067】送信電力設定手段225から基準信号であることを送信電力取得手段226に伝え、送信電力取得手段226は基準信号を送信することを送信データ作成手段224に伝える。送信データ作成手段224は自局の識別情報と基準信号であることを識別できる情報を含む基準信号データを作成する。基準信号データは、送信データ変換部208と送信部207を通過してアンテナ201から基準信号として送信される。

【0068】図8は無線POS端末装置3が通信する相手となる携帯端末装置を決定するときの無線POS端末装置と携帯端末装置との信号のやり取りを示す流れ図で、まず、無線POS端末装置3が、ST51にて問い合わせ信号を携帯端末装置に送信する。問い合わせ信号は、自局の識別情報を含ませて不特定多数の携帯端末装置に宛てた問い合わせである。携帯端末装置が周囲に存在しない場合は、ST52における応答有無の判定において応答無しが判定され、ST51の問い合わせ信号の送信に戻る。

【0069】一方、携帯端末装置は、ST71にて受信待ち状態にあり、ST72にて問い合わせ信号の受信を判定すると、ST73にて問い合わせをしてきた無線POS端末装置3の識別情報と自局の識別情報を含ませた応答を送信する。携帯端末装置は、問い合わせ信号を受信したときに無線POS端末装置との送受信タイミングの同期を取り、通信リンクを確立する。このとき使用する通信方法によっては送受信タイミングの同期を取るためにさらに無線信号のやり取りが発生することがある。

【0070】無線POS端末装置3は、ST52にて応答有りを判定すると、ST53にて応答のあった携帯端末装置宛てに、基準信号送信要求を送信する。基準信号は、送信先の識別情報と送信元の識別情報と基準信号であることを知らせる識別情報を含んでおり、送信電力を

予め規定しておく。携帯端末装置は、ST74にて基準信号送信要求を受信すると、ST75にて無線通信制御部206が送信電力制御部209に設定を行い、基準信号の送信電力として規定された送信電力で送信するように、送信部207の設定を行う。

【0071】その後、ST76にて基準信号を送信する。無線POS端末装置3は、基準信号の受信待ちにあり、ST54にて基準信号を受信できたかを判定する。一定時間以上経過しても基準信号を受信できない場合は、基準信号要求を送信した携帯端末装置が通信を行う範囲内に近づいていないと判断し、ST51に戻る。

【0072】基準信号を受信するとき、受信信号強度表示部205からRSSI値が受信電力取得手段221に入力され、受信電力を取得し、距離推定手段223に伝えられる。基準信号の送信電力は予め分かっているため、ST55にて基準信号の送信電力と受信した携帯端末装置の受信電力から距離を推定する。

【0073】基準信号の送信電力を $P_t$  (dBm)とし、無線POS端末装置3が受信する電力を $P_i$  (dBm)とし、無線電波の波長を $\lambda$  (m)とすると、携帯端末装置と無線POS端末装置3との距離 $D$  (m)は前述した(1)式を用いることで算出できる。

【0074】こうして距離の推定を行うと、続いて、ST56にて推定した距離が閾値内にあるかを判定する。無線POS端末装置3と携帯端末装置との距離が閾値内であれば、ST57にて待機している携帯端末装置へ送信するためのタイマ割り込みを禁止する。また、無線POS端末装置3と携帯端末装置との距離が閾値を越えていれば、処理は図9のC1へ移行する。

【0075】その後、無線POS端末装置3は、ST58にて通信開始を知らせる通信開始信号を携帯端末装置に送信し、ST59にて通信を行う。一方、携帯端末装置は、ST77にて通信開始であるかを判定し、通信開始信号を受信した場合は、ST78にて通信を開始する。また、通信開始信号を受信しない場合は、処理は図9のD1へ移行する。

【0076】このようにして、無線POS端末装置3はST59にて通信を行い、携帯端末装置はST78にて通信を行い、情報の交換等の処理を行う。

【0077】図1において順番待ちで並んでいる人が所有している携帯端末装置2のように、直ぐに無線POS端末装置3に近づくであろう携帯端末装置については、携帯端末装置との通信リンクは確立したままにする。

【0078】携帯端末装置からST76にて送信された基準信号が、POS端末装置3で受信され、ST56にて距離が閾値よりも遠いと判断されると、図9のC1に移行し、ST60にて距離が第2の閾値である待機範囲内に入っているか否かを判定する。

【0079】携帯端末装置が待機範囲外であると判断された場合は、POS端末装置3はその携帯端末装置と通

信を行わないと判断し、ST51に戻る。このとき、携帯端末装置は、一定時間経過してもST77にて通信開始信号の受信がなく、ST79にて待機信号も受信しないため、ST71に戻る。

【0080】無線POS端末装置3が、携帯端末装置が待機範囲内に存在していることを判断した場合は、ST61にて携帯端末装置に待機信号を送信する。携帯端末装置はST79にて待機信号を受信すると、ST80にて送受信タイミングの同期を保持したまま受信待ちとなる。

【0081】無線POS端末装置3は、待機信号を送信した後、携帯端末装置との送受信タイミングの同期保持と距離の確認をするために定期的に通信を行う。ST62にて待機させた携帯端末装置に対して一定時間後に送信ができるようにタイマ割り込みの設定を行い、ST61に戻る。このタイマは設定時間後にタイマ割り込みが発生し、タイマ割り込みに移行する。

【0082】次に、他の携帯端末装置を探すために、ST51にて問い合わせ信号の送信をする。POS端末装置3は、待機させた携帯端末装置よりも後に通信を行う携帯端末装置を見つけた場合は、ST57にて待機している携帯端末装置へのタイマ割り込みを禁止し、ST59の通信終了後に、待機携帯端末装置へのタイマ割り込み禁止を解除すればよい。

【0083】これにより、無線POS端末装置3と携帯端末装置が通信を行っているときに、無線POS端末装置3は待機中の携帯端末装置との送受信が発生しなくなり、効率よく通信を行うことができる。

【0084】無線POS端末装置3が携帯端末装置を探しているときに、タイマ割り込みが発生すると、ST63にて待機中の携帯端末装置宛てに基準信号送信要求を送信する。携帯端末装置は、ST81にて基準信号送信要求を受信すると、ST82にて基準信号を送信し、ST77に戻る。

【0085】待機中の携帯端末装置は、既に基準信号を送信する送信電力に設定されているため、基準信号送信要求を受信した後に送信電力を設定する必要はないが、基準信号を送信する送信電力に再設定を行っても問題はない。

【0086】無線POS端末装置3は、ST64にて基準信号を受信するときに、受信電力の取得も行う。そして、ST65にて送信電力と受信電力から距離を推定する。距離の推定方法はST55のときと同じである。そして、ST66にて距離が閾値内であると判断された場合は、ST57に戻り、携帯端末装置と通信を行うことになる。また、ST66にて距離が閾値外であると判断された場合は、ST60に戻って携帯端末装置が待機範囲内であるかを判断することになる。

【0087】このようにすることにより、携帯端末装置を所有する人が無線POS端末装置3の前で精算待ちを

していて、携帯端末装置が待機状態にあり、無線POS端末装置3との送受信タイミングの同期が取れていれば、その人の順番になり無線POS端末装置に近づいたとき、直ちにそのPOS端末装置3と無線通信を行うことができる。

【0088】なお、問い合わせ信号を携帯端末装置から送信してもよい。すなわち、携帯端末装置を所有している人が無線POS端末装置と通信を行う順番になったら携帯端末装置を操作することにより、問い合わせ信号をPOS端末装置に送信する。無線POS端末装置は、問い合わせ信号を受信すると、応答をし、携帯端末装置に基準信号の送信要求を送信すればよい。

【0089】なお、前述した各実施の形態では使用する無線POS端末装置を1台としたが必ずしもこれに限定するものではなく、複数台使用したものであってもよい。無線POS端末装置が複数台ある場合は、POS端末装置は他のPOS端末装置の問い合わせ信号には応答しないように設定しておけばよい。すなわち、POS端末装置の識別情報は設置時にわかっており、問い合わせ信号の中にPOS端末装置の識別信号を含ませれば、他のPOS端末装置の問い合わせ信号には応答しないようにすることが可能となる。これにより、POS端末装置間の不要な通信を無くすることができる。

【0090】また、第1の実施の形態において携帯端末装置からPOS端末装置に送信される、送信電力を最小にした応答信号、及び第2の実施の形態において携帯端末装置からPOS端末装置に送信される基準信号を、複数回送信し、POS端末装置はこの信号を受信し、受信毎にRSSI値を読み取り、複数回の結果から閾値内の距離であるかを判断してもよい。

【0091】すなわち、前述した(1)式の( $P_i - P_t$ ) (dB)を無線区間における電力の減衰量として、距離との関係を示すと図10に示ようになる。この関係は、POS端末装置の近くで減衰量が10dB程度変動しても距離は大きな変化はないが、POS端末装置から3m位離れた位置では減衰量が5dB程度変化すると距離が1m以上変化することを示している。このことから、複数回の送信出力値とRSSI値の読み取り結果から求めた距離のばらつきが小さいときに通信範囲内にあると判断してもよい。

【0092】なお、前述した各実施の形態においては、第1の無線通信装置を携帯端末装置、第2の無線通信装置を無線POS端末装置とし、無線POSシステムに本発明を適用したものについて述べたが必ずしもこれに限定するものでないのは勿論である。

【0093】

【発明の効果】以上詳述したように、請求項1乃至8記載の発明によれば、無線通信装置が不特定多数の無線通

信装置から通信を行う無線通信装置を特定して無線通信を行う場合に、面倒な手間をかけることなく無線通信を行うことができる無線通信方法を提供できる。

【0094】また、請求項9乃至12記載の発明によれば、無線通信装置が不特定多数の無線通信装置から通信を行う無線通信装置を特定して無線通信を行う場合に、面倒な手間をかけることなく無線通信を行うことができる無線通信システムを提供できる。

【図面の簡単な説明】

【図1】本発明の第1の実施の形態に係るシステム構成を示すブロック図。

【図2】同実施の形態における無線POS端末装置の構成を示すブロック図。

【図3】図2における無線POS端末装置の無線通信制御部の構成を示すブロック図。

【図4】同実施の形態における携帯端末装置の構成を示すブロック図。

【図5】図4における携帯端末装置の無線通信制御部の構成を示すブロック図。

【図6】同実施の形態において無線POS端末装置が通信する相手となる携帯端末装置を決定するときの無線POS端末装置と携帯端末装置との信号のやり取りを示す流れ図。

【図7】同実施の形態において無線POS端末装置が通信する相手となる携帯端末装置を決定するときの無線POS端末装置と携帯端末装置との信号のやり取りを示す流れ図。

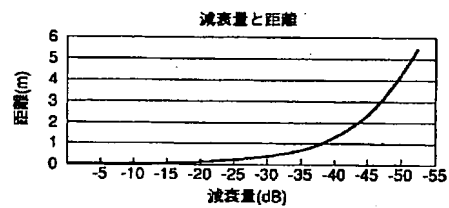
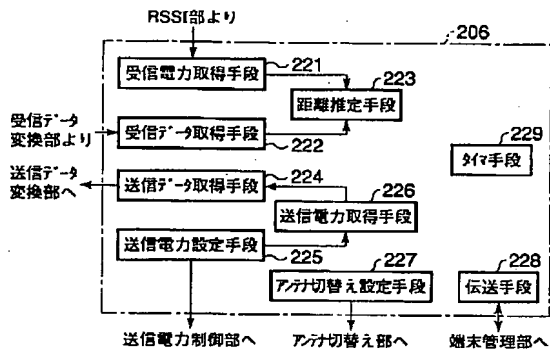
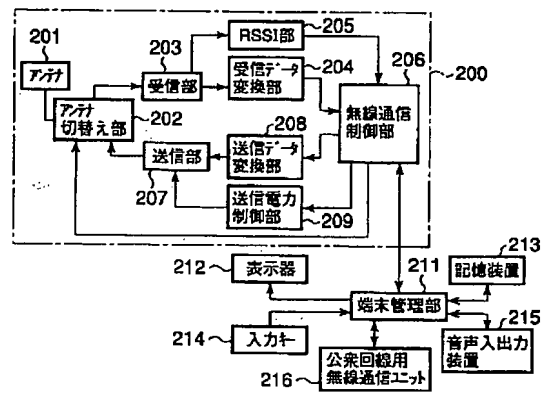
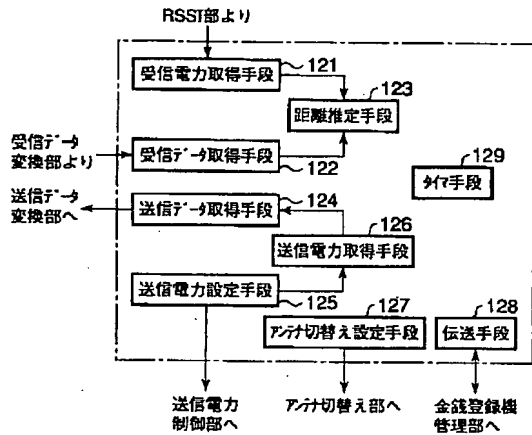
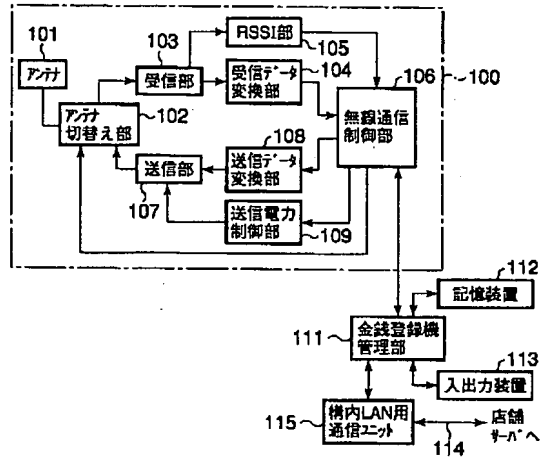
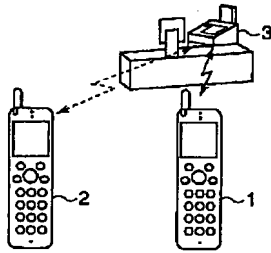
【図8】本発明の他の実施の形態において無線POS端末装置が通信する相手となる携帯端末装置を決定するときの無線POS端末装置と携帯端末装置との信号のやり取りを示す流れ図。

【図9】同実施の形態において無線POS端末装置が通信する相手となる携帯端末装置を決定するときの無線POS端末装置と携帯端末装置との信号のやり取りを示す流れ図。

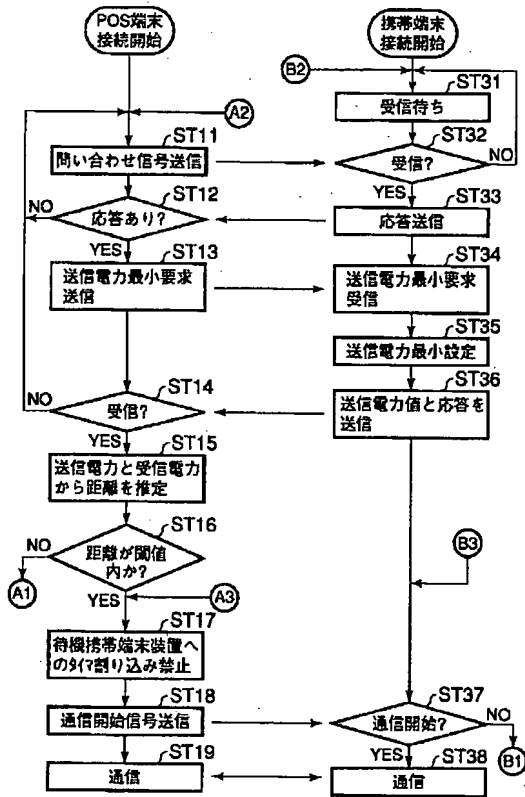
【図10】電力の減衰量と距離との関係を示すグラフ。

【符号の説明】

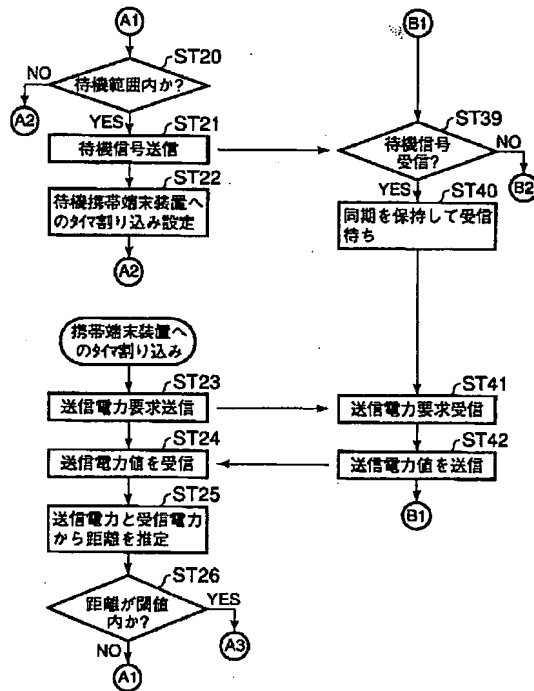
- 1, 2…携帯端末装置 (第1の無線通信装置)
- 3…無線POS端末装置 (第2の無線通信装置)
- 100, 200…無線部
- 106, 206…無線通信制御部
- 121, 221…受信電力取得手段
- 122, 222…受信データ取得手段
- 123, 223…距離推定手段
- 124, 224…送信データ作成手段
- 125, 225…送信電力設定手段
- 126, 226…送信電力取得手段



【図 6】



【図 7】



【図 8】

